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Training methods and tactical decision-making simulations

Ayvaz, Ümit; Fitzpatrick, C. Neil, III

Monterey, California. Naval Postgraduate School

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THESIS

TRAINING METHODS AND TACTICAL DECISION-MAKING SIMULATIONS

by

C. Neil Fitzpatrick III
Ümit Ayvaz

September 2007

Thesis Advisor:	Amela Sadagic
Co-Advisor:	Anthony Ciavarelli

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Introducing simulation training to ground officers for the first time, within an existing proven curriculum, presents a number of challenges and questions. The proper amount of simulation time to evaluate and train skill sets and how to introduce simulation into an existing curriculum are mostly unknown. We have completed two studies at the Naval PostGraduate School (NPS). The first study examined the length of time and the most appropriate method for introducing simulation training to a user. The second study compared the use of the Close Combat Marines (CCM) Tactical Decision-Making Simulation (TDS) with the traditional method of training decision-making called the Tactical Decision-Making Game (TDG). The TDS and TDG were used in a between-subjects experimental design to examine the viability of each with regard to their ability to evaluate several important military traits. We found that both the TDG and the TDS methods were useful in evaluating a participant's leadership characteristics and decision-making ability. However, only the TDS was capable of evaluating situational-awareness. Our results also address a novel way in which these two approaches could be combined to amplify each other's potential in training of ground officers and military personnel in general.

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TRAINING METHODS AND TACTICAL DECISION-MAKING SIMULATIONS

Charles N. Fitzpatrick III
Major, United States Marine Corps
Bachelor of Environmental Design (B.E.D.), Texas A&M University, 1990

Ümit Ayvaz
Captain, Turkish Army
B.S., Systems Engineering, Turkish Military Academy, 1997

Submitted in partial fulfillment of the
requirements for the degree of

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NAVAL POSTGRADUATE SCHOOL
September 2007

Authors: Charles Neil Fitzpatrick III

Ümit Ayvaz

Approved by: Amela Sadagic, Ph.D.
Thesis Advisor

Anthony Ciavarelli, Ph.D.
Co-Advisor

Rudolph Darken, Ph.D.
Chair, Department of MOVES

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ABSTRACT

Introducing simulation training to ground officers for the first time, within an existing proven curriculum, presents a number of challenges and questions. The proper amount of simulation time to evaluate and train skill sets and how to introduce simulation into an existing curriculum are mostly unknown. We have completed two studies at the Naval Postgraduate School (NPS). The first study examined the length of time and the most appropriate method for introducing simulation training to a user. The second study compared the use of the Close Combat Marines (CCM) Tactical Decision-Making Simulation (TDS) with the traditional method of training decision-making called the Tactical Decision-Making Game (TDG). The TDS and TDG were used in a between-subjects experimental design to examine the viability of each with regard to their ability to evaluate several important military traits. We found that both the TDG and the TDS methods were useful in evaluating a participant's leadership characteristics and decision-making ability. However, only the TDS was capable of evaluating situational-awareness. Our results also address a novel way in which these two approaches could be combined to amplify each other's potential in training of ground officers and military personnel in general.

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LIST OF ACRONYMS AND ABBREVIATIONS

AAR - After Action Review

ACC - Adaptive Cruise Control

AIDT - Action Inference Decision Tree

ANOVA - Analysis of Variance

AWC - Army War College

CCM - Close Combat Marines

CEER - College Entrance Equivalency Rating

COA - Course of Action

COC - Combat Operation Center

COTS- Commercial Off The Shelf

CPU - Central Processing Unit

DM - Decision-Making

DQT - Direct Questioning Technique

FM - Field Manual

GRADE - Geographical Recall and Analysis of Data in the Environment

HISL - Human Systems Integration Lab

HMD - Head Mounted Display

HSI - Human Systems Integration

IDF - Israeli Defense Forces

IOBC - Infantry Officers Basic Course

IPSC - Infantry Platoon Sergeants Course

IRB - Institutional Review Board

LBP - Leader Behavior Preferences

LOC - Locus of Control

MAGTF - Marine Air Ground Task Force

MD - Military Development

MDMP - Military Decision-Making Process

METT-T - Mission, Enemy, Terrain, Troops, Time

MOUT - Military Operations in Urban Terrain

MOVES - Modeling Virtual Environments and Simulation

NAVAIR - Naval Air Systems Command

NCO - Non-Commissioned Officer

NEOAC - Neuroticism, Extraversion, Openness, Agreeableness, and Conscientiousness

NMSO - Navy Modeling and Simulation Office

NPS - Naval Postgraduate School

OIF - Operation Iraqi Freedom

SA - Situational Awareness

SAGAT - Situational Awareness Global Assessment Technique

SARS - Situational Awareness Rating Scales

SART - Situational Awareness Rating Technique

SE - Systems Engineering

SME - Subject Matter Expert

SPAWAR - Space and Naval Warfare Systems Command

TBS - The Basic School

TDG - Tactical Decision-Making Game

TDS - Tactical Decision-Making Simulation

TTP - Tactics, Techniques, and Procedures

UTP - Unshielded Twisted Pair

VE - Virtual Environment

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Ümit Ayvaz

I am grateful to my beloved country, Turkey, for having given me an outstanding and invaluable opportunity to study at the Naval Postgraduate School. I would like to thank my thesis partner, Major C. Neil Fitzpatrick, for being an unforgettable friend from the beginning to the end of my time at NPS. I would, also, like to thank my wife, *Burcu AYVAZ,* my father, *Ahmet AYVAZ,* my mother, *Esma AYVAZ, and my sister Melek DURMUŞ* for their love and continual support from thousands of miles away. Without their patience and understanding, I would not have had the perseverance to complete this thesis.

C. Neil Fitzpatrick III

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I. INTRODUCTION

A. PROBLEM STATEMENT

Traditional training of military ground officers in tactics has evolved over the decades into a proven *crawl, walk, run* approach. Students are first taught the tactics, techniques, and procedures (TTPs) in a classroom that they will later execute in the field. The second phase is rehearsal in a controlled environment. This is still one step removed from actual implementation. Finally, after they have mastered the TTPs, they are encouraged to apply this knowledge in a training session that, most closely, approximates the real world in hopes that the jump from training to real will be as small as possible. Training results over time have shown that this methodical approach is an effective way to learn complex skills and team tasks. However, military educators have struggled with important questions about introducing a new category of computer-based instruction into an otherwise proven curriculum.

As technology has increased over the last 20 years, military educators have begun to incorporate various forms of simulation and computer-based training into the *crawl* and *walk* phases of ground officer training. School administrators and teachers chose this approach because it made practical sense and provided a safe environment in which to train. Using this particular form of training system, students can make mistakes with few detrimental consequences. Some studies have demonstrated that simulation technology can help students learn faster, acquire more skills during sessions, and retain the knowledge for a longer period. Some types of simulation training expose people to training situations that would otherwise be extremely difficult to implement. Real world training, such as artillery call-for-fire or close air support training, can be very costly in terms of the number of units involved, time, and amount of resources required. To train one officer in a call-for-fire mission or a close air support task, with real assets, requires artillery pieces firing and/or aircraft flying. In a virtual environment, it is possible to train many personnel in these domains at one time without the cost of real supporting assets.

These are only some of the important benefits that simulation can offer to the military when real world environments are found to be cost prohibitive. Simulation should not be considered the ultimate replacement for real world field exercises because there are benefits that real world training can offer the student that simulation cannot. However, it can bridge the gap left open when real world training cannot be accomplished for various reasons.

Many studies have explored simulation training relative to aviators, but few have examined it specifically for use among ground officers. The challenge is not introducing it in the first place, but to identify the most effective way to introduce and use it in training practice. Young officers, who are in the early stages of their training, might benefit from a targeted application of simulation technology. These early stages could be the location in the training cycle where simulation methods could prove to be the most useful.

This study will focus on a comparative evaluation of a traditional method and a new type of simulation training. We trust that these insights will help answer questions, as well as, offer guidelines to a military school that is considering the integration of simulation into its training cycle. The answers to these questions will doubtlessly influence the welfare of military trainees who will be a part of the real world engagements soon after the completion of their training regimens.

B. RESEARCH QUESTIONS

Here is a list of questions that provided much of the motivation for our work. These questions were not only of interest to us personally, but, also, to the U.S. Marine Corps' Basic School at Quantico, Virginia:

- How much time is needed to familiarize a student with the system before training can actually begin?
- Can a Tactical Decision-Making Simulation (Close Combat Marines (CCM)) be used to evaluate leadership?
- Are there objective measures of leadership, decision-making, and situational awareness that can be evaluated with a TDG and a TDS?

- What are the training differences between using a TDS and a TDG? Do they train the same skills? If so, what is the amount of training time required for each?
- Do the TDG and TDS enhance the ability of the user to visualize the battle space?
- How many sessions are necessary to obtain a particular level of competency in tactical decision-making?
- Should TDG and TDS training be mutually exclusive or should they be used in a combined training approach?
- Should simulation be used in a controlled instructor-led environment or should students be allowed to exclusively explore and learn on their own?

This research, and the subsequent studies, was the result of our desire to explore the previous concepts and questions. We addressed a selected set of research questions and elaborated upon them in this thesis. The remaining research questions were considered, but not fully explored in the document.

C. SCOPE

The scope of this thesis will focus on the previous research questions and the evaluation of leadership, decision-making, and situational awareness by using two training methodologies. We will seek to provide answers to military training commands about the use of tactical decision-making simulations in their training curricula. We will compare and contrast the tactical decision-making game (TDG) and the tactical decision-making simulation (TDS) to see which of these approaches is best able to improve the efficiency and the effectiveness of training in the military environment.

D. ORGANIZATION OF THESIS

This thesis is organized in the following chapters:

- Chapter I - Introduction. This chapter provides the motivation for this work, the research questions asked, and the framework for pursuing answers to these questions.
- Chapter II - Background. This chapter is a literature review of scientific studies and experiments that have contributed to the understanding of leadership, decision-making, and situational awareness. The analysis and introduction of the tactical decision-making game and tactical decision-making simulation were, also, included. We, also, examined literature on

a Tactical Decision-Making Simulation (TDS), called Close Combat Marines, which the U.S. Marine Corps is using in its introductory officer and non-commissioned officer training.

- Chapter III - Experiments. We conducted two experiments. The analysis of the data collected in each was the basis for all conclusions from this work.
- Chapter IV - Recommendations and Future Work. This chapter discusses lessons learned from both experiments and offers suggestions for future experiments and studies. It, also, provides recommendations for future versions of tactical decision-making simulations like CCM.

II. BACKGROUND

A. INTRODUCTION

There are many skills and attributes that young officers must acquire and cultivate to become effective military leaders. Leadership, decision-making (DM), and situational awareness (SA) are three essential characteristics of good military leaders. It is, therefore, understandable that all military schools endeavor to train, cultivate, and evaluate their students on these skills. At the Basic School in Quantico, Virginia, Marine Corps lieutenants are taught the basics of infantry combat. The Basic School's mission is to, "Train and educate newly commissioned or appointed officers in the high standards of professional knowledge, esprit-de-corps, and leadership required to prepare them for duty as company grade officers in the operating forces, with particular emphasis on the duties, responsibilities, and warfighting skills required of a rifle platoon commander" (U.S. Marine Corps The Basic School Website, 2007).

All military officers must lead. For them to lead effectively, they must be able to make timely decisions and clearly understand the situations unfolding around them. This rationale led us to select and conduct a study of leadership, decision-making, and situational awareness when Tactical Decision-Making Games (TDGs) and Tactical Decision-Making Simulations (TDSs) are used as training methods.

B. LITERATURE REVIEW

In this section, we provide a review of literature that served as a basis and a starting point for our work. The topics include leadership, tactical decision-making, situational awareness, tactical decision-making game training practice, and tactical decision-making simulations.

1. Leadership

As J.M. Burns stated in his book entitled *Leadership*, "Leadership is one of the most common and least understood phenomena in the world" (as cited in Popper, 1996, p. 15). This subject has been the center of learned discussion for millennia. Thinkers

have debated its origin, nature, and the subtle differences between what some call leadership and others call management. Leadership is a quality that many claim to know when they see, but generally have difficulty describing. Perhaps this is because the subject is vast and has so many facets that require analysis, review, and research. The nature of this work will be to focus on how leadership may be measured and documented. If needed, those measures could be used as additional guidance when deciding what specialization should be suggested to young officers. The authors will examine only a few of the most prominent theories and methodologies for measuring leadership, both in the real world, as well as in virtual environments (VE)s.

a. History of Leadership Thought and Doctrine

Early leadership theory can be traced back to ancient civilizations in Egypt, Babylon, Eastern Asia, and Greece. The 6th century B.C. Chinese writer, Lao-Tzu, described the qualities of "the wise leader…as selfless, hardworking, honest, able to time the appropriateness of actions, fair in handling conflict, and able to empower others… Aristotle argued in Politics that leaders were to help others seek virtue; they would do so by themselves being virtuous" (Antonakis, Sternberg, 2004, p. 101). One could easily argue that good leadership has eternal characteristics. If the qualities can be defined, captured, and, measured, could they be sufficient to determine if someone is a leader and, if so, one that is good or bad?

Leadership has had many definitions. J. Kotter, writing the in Harvard Business Review, says simply that leadership is "getting people to act without coercion" (as cited in Popper, 1996, p. 15). Internationally known professor and author, Henry Mintzberg, believes that "the manager (like a military commander) does many things: coordination, logistics, management of information, budgets, and so forth. One of their roles is leadership: motivating people to perform tasks to the best of their ability" (as cited in Popper, 1996, p. 15). These two definitions hint at a subtle difference between managers and those who lead. There are two competing philosophies when seeking to articulate the definition of leadership. Throughout history, great leaders exhibited certain qualities. How they obtained these qualities is the crux of this long-standing controversy.

Are these traits innate or are they learned? One belief is that any person, who so desires, may learn the traits associated with effective leadership and implement them ("*learned trait*" approach). If he is able to do so, then he will be an effective leader. The other view is that these traits are not learned, but innate. This is the classic argument that leaders are born, not made. The "*born not made*" philosophy asserts that the quantification of leadership characteristics are for the identification of leaders, not for the training of such. To measure the effectiveness of a leader, one must identify and categorize those traits/qualities, form a scale on which to measure each of them, evaluate them individually, and finally examine them collectively. However, an additional element must be present in both cases. A person, who has these qualities, whether learned or born, must aspire to leadership. He must, also, want it. If not, he will avoid opportunities to lead and never realize his potential.

b. Modern Military Leadership Training

The U.S. military establishment ascribes to a *learned-trait approach*. In the military, and over the last 35 years of the all volunteer force, those who have entered service, especially in the officer corps, are assumed to have this desire to lead because they are self-selected. Desire is assumed, as well as the notion that leadership can be taught. The U.S. Marine Corps Officer Candidate School even has this notion codified in its mission statement: "…to educate, train, evaluate, and screen officer candidates to ensure they possess the moral, intellectual, and physical qualities for commissioning, and the leadership potential to serve successfully as company grade officers in the operating forces" (USMC Officer Candidate School website). Terms, such as "educate," "train," and "leadership potential" all imply that there exists a capability to learn the tenants of leadership. Also, that there is some ability toward leading other people that can be acquired. The Marines have compiled a list of fourteen leadership traits considered to be essential elements that leaders of all organizational levels are encouraged to acquire and master. They are: Justice, Judgment, Dependability, Initiative, Decisiveness, Tact, Integrity, Enthusiasm, Bearing, Unselfishness, Courage, Knowledge, Loyalty, and Endurance.

Retired Army Lieutenant General Walter F. Ulmer Jr. argued, in a January/February 2006 article from Armor magazine, that leadership is not a collection of "traits, personality, ambition, intellect, energy, and personal goals," but "in practical terms, the process of leading is best measured not by attributes or characteristics, but by the specifics of what leaders do" (Ulmer, 2006, p. 39). He goes on to discuss a study of four division commanders who had just completed tours of duty in Operation Iraqi Freedom (OIF). This study examined "behaviors that are crucial for contemporary leader effectiveness" (Ulmer, 2006, p. 39) In addition to this study, Lieutenant General Ulmer looked at several other historical studies and found that a number of specific behaviors continued to surface in leaders who were widely thought of as good. He compiled a list from a variety of different levels of leadership. It was refined by an Army War College (AWC) group of professors and students into a list containing thirty items as seen in Figure 1. These have been further refined in Figure 2 into a subset called, the "Big 12."

Leader Behavior Preferences (LBP) Worksheet

(Behaviors that create a command climate that supports operational excellence and motivates competent people to continue military service.)

Specific leader behavior (for a division commander)				
1. Adapts quickly to new situations and requirements.				
2. Understands and employs current Army and Joint doctrine.				
3. Keeps cool under pressure.				
4. Knows how and when to involve others in decisionmaking.				
5. Clearly explains missions, standards, and priorities.				
6. Sees the big picture; provides context and perspective.				
7. Sets high standards without a "zero defects" mentality.				
8. Encourages initiative and welcomes new ideas.				
9. Backs up subordinates; confronts the boss if necessary.				
10. Is trustworthy; keeps promises or explains why he can't.				
11. Employs units in accordance with their capabilities.				
12. Can handle "bad news."				
13. Gets out of the headquarters and visits the troops.				
14. Coaches and gives useful feedback to subordinates.				
15. Sets a high ethical tone; demands honest reporting.				
16. Will share the risks and hardships of his soldiers.				
17. Knows how to delegate and not "micromanage."				
18. Is consistent and predictable in his behavior.				
19. Shows respect and consideration for others of any rank.				
20. Puts mission and people ahead of his own career.				
21. Is approachable; listens to questions and suggestions.				
22. Can make tough, sound decisions on time.				
23. Shares the limelight; gives due credit to others.				
24. Senses unproductive policies and makes prompt adjustments.				
25. Builds and supports teamwork within staff and among units.				
26. Holds people accountable for their actions and results.				
27. Is more interested in doing good than looking good.				
28. Is fair; doesn't play favorites with units or people.				
29. Is positive, encouraging, and realistically optimistic.				
30. Write in:				

Figure 1.

Note: This list may be reproduced with credit to AWC Study "Leadership Lessons at Division Command Level–2004."

Figure 1. Leader Behavior Preferences (LBP) Worksheet (From: Ulmer, 2006)

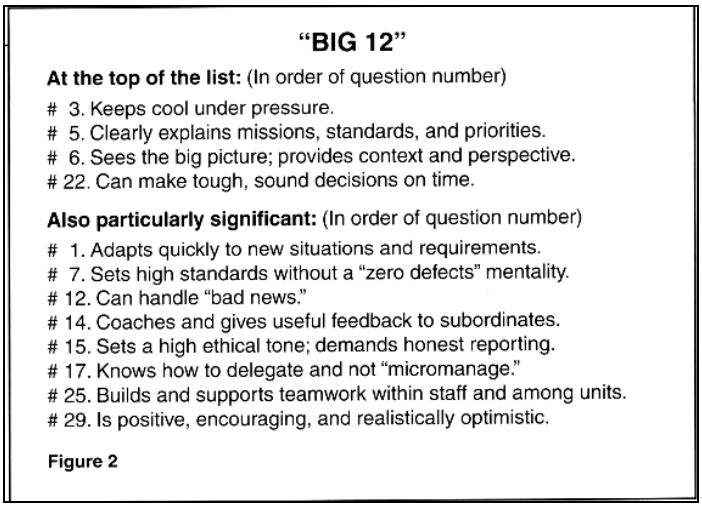


Figure 2. The "Big 12" (From: Ulmer, 2006)

Micha Popper, Professor of Psychology of Haifa University, Haifa, Israel, compares leadership in the military and management in the business world. Some might argue that these are two names for the same thing. However, Popper demonstrates that there is a qualitative difference between the perceptions of a leader in and outside the military context. In a 1981 study examining leadership styles of military officers in Viet Nam, Gabriel and Savage assert that military leadership in Vietnam was overly influenced by a business-like sterile managerial style and not in keeping with traditional military leadership principles. This over reliance, or commercial management techniques, led to disastrous consequences in Viet Nam (as cited by Popper, 1996). Popper describes two very different relationships that exist between the leaders and the led:

1. *The Transactional Leader* - The transactional leader is the leader who assesses his team's psychological needs and determines the link between their amount of effort and reward for that effort. He is "transactional" in the sense that he is a broker of tangible and intangible incentives that are used to persuade his followers to accomplish some goal. This is most associated with a successful businessperson who orchestrates a connection between corporate goals and team performance (Popper, 1996).

2. *The Emotional Leader* - The emotional leader is quite different, though he may still have a transactional element to his nature. He leads primarily by eliciting positive emotional responses from his followers.

> The emotional leader is one who "may be described by images, such as charismatic, visionary, and inspirational" (Popper, 1996, p. 16). The emotional leader is generally more common in military environments where tangible incentives are less common and intangibles dominate. This is the type of leader who is capable of arousing emotions so strong that "people are even willing to sacrifice their lives for the leader (Popper, 1996, p. 16).

c. Leadership Studies

(1) Measuring Military Development (MD). In the opening chapter of his book, *The West Point Way of Leadership*, retired Army Colonel Larry R. Donnithorne describes West Point's philosophy of leadership:

> At every Fortune 500 institution in America, people are taught ethics. At West Point, people are taught character...A leader of character has all the qualities we normally associate with leaders' ambition, confidence, courage, intelligence, eloquence, responsibility, creativity, compassion and one thing more which we unfortunately overlook too frequently among civilian leaders: A leader of character is absolutely trustworthy, even in times of great stress, and can be depended upon to put the needs of others, the organization, the community above personal considerations, not now and then, or when the spirit moves him, or when it will look good on his resume, but in every instance (Donnithorne, 1994).

Paul Bartone, Scott Snook, and Trueman Tremble (2002), embarked on a 4-year longitudinal study of West Point cadets (N=1143) that examined the influence of cognitive and personality variables on military leadership performance. Due to attrition of some 25% of the cadet class over the course of four years, the final number of cadets in the study was N=855. A cross-validated hierarchical multiple regression procedure was used to determine the factors upon entry that successfully predicted military development grades in upper-classmen. The following potential traits were identified as potential predictors of leader performance:

- Spatial Judgment
- Logical Reasoning
- Social Judgment
- Problem Solving
- College Entrance Equivalency Rating (CEER)

In addition to the previous five predictors of leadership performance, the researchers, also, examined personality based on the Neuroticism, Extraversion, Openness, Agreeableness, and Conscientiousness (NEOAC) personality inventory (Costa & McCrae, 1985). The process used to evaluate these predictors was to first examine the potential affects of the varying demographic variables (sex, race, age) on upperclassman leader performance scores. Then, move further into analyzing the cognitive and personality variables. If correlations were not established, then that particular variable was dropped from further consideration (Bartone, Snook, Tremble, 2002).

The researchers examined demographic, cognitive, and personality variables with the following results: There was no correlation found between the demographic variables of race and age with leader performance scores; thus, these were dropped. There was a correlation with sex; thus, this variable was retained for further consideration. Of the cognitive variables considered in the study, problem solving and spatial judgment (mental figure rotation) did not correlate with leader performance scores. These were, also, dropped from further consideration. Logical reasoning, social judgment, and CEER did correlate significantly with leader performance and were kept for additional analysis. Of the personality variables, neuroticism and openness did not correlate with leader performance scores and were not analyzed further. Extraversion, agreeableness, and conscientiousness did correlate with leader performance; thus, they were kept (Bartone, Snook, Tremble, 2002). After the preliminary correlations, the following variables remained for consideration: sex, logical reasoning, social judgment, CEER score, extroversion, agreeableness, and conscientiousness. Based on a multiple regression analysis, the authors state that the previously mentioned demographic, cognitive, and personality variables must be considered predictive of leadership performance over time. After two hierarchical multiple regression analyses were done on these data, all variables were eliminated, leaving sex, college entrance scores, social judgment, and conscientiousness as predictors of leadership performance.

(2) Popper's Big Three and Their Subcategories. Professor Micha Popper asserts that there are three types of psychological capacities that are essential for leadership: self-confidence, a proactive orientation, and a capacity for pro-social relationships. The three capacities cited here by Dr. Popper are based on the initial research of professor and author Bernard Bass (Bass, 1990). In the study published in Military Psychology in 2004, Popper et al. administered questionnaires to 402 Israeli Defense Force (IDF) soldiers from infantry and armor corps units as they approached the end of their basic training. These were compared with a socio-metric questionnaire examining the peer and commander evaluations of the soldiers' leadership capacities which, in-turn, were used to evaluate each soldier and to classify the soldiers either as leaders or non-leaders. Findings from this study revealed a significant difference between leaders and non-leaders in all variables defined as psychological capacities to lead (Popper, 2004). The researchers evaluated participants on the following levels:

1. Locus of Control (LOC) - refers to the capacity that one believes he has to control events in his life.
2. Self-Confidence - consists of internal locus of control, low level of trait anxiety, and self-efficacy.
3. Trait Anxiety - is characterized by the degree to which a person will either exhibit, or not exhibit, symptoms of stress when faced with a variety of situations.
4. Self-efficacy - is defined as a person's belief that he can face and accomplish a task or perform successfully when presented with a goal.
5. Proactive Orientation - is measured by level of optimism.
6. Capacities Required for Pro-Social Relationships - is a measure of how well the person gets along with others.

Popper's findings resulted in the following conclusions. From the above six measures, leaders were found to exhibit:

1. Higher levels of internal locus of control when compared to non-leaders.
2. Lower levels of anxiety compared with non-leaders
3. Higher levels of self-efficacy compared with non-leaders.
4. Higher levels of optimism compared with non-leaders.

5. Higher levels of secure attachment style compared with non leaders.
6. Lower avoidant and anxious attachment styles compared with non-leaders (Popper, 2004, p. 257).

d. Measuring Leadership in a Virtual Environment (VE)

Leadership in a virtual environment is not that far removed from leadership in real environments. Many of the characteristics for evaluating leadership potential are essentially the same. However, research conducted by Steed, et al. in 1999, a group of researchers specializing in real time virtual environments from the University College in London, demonstrated that, in some cases, immersion within a virtual environment was positively correlated with leader behavior.

In this paper, researchers discussed a series of three studies that investigated small group collaboration within a virtual environment. Groups consisted of three individuals who were tasked with solving a task that required a high degree of collaboration among the participants. The participants manipulated avatars that were colored red, green, and blue. They initially met in a virtual room and, then, were tasked with solving a series of puzzles that consisted of fragmentary statements that were written on pieces of paper hung on the walls in different parts of the virtual environment. The participants were required to locate all pieces of paper, and rearrange the phrases on each individual sheet to form an intelligible sentence. After the sessions, the researchers examined the relationships between the resources, presence, co-presence, immersion, group accord, and leadership.

Study 1 - The first experiment was conducted with all participants located at the same university. In this study, two of the participants worked on desktop computers and the third participant was immersed via a head-mounted display (HMD). They started the task in a virtual environment and finished it in a real environment. There were ten groups of three that went through this study. The results suggested that the person who was immersed with the HMD tended to emerge as the leader for a significant amount of time. Additionally, group accord tended to be higher in the real meeting than in the virtual meeting.

Study 2 - The second experiment recreated the first study, but conducted the study over a wide area network. In this study, no real environment was present. All participants were placed in and remained in the virtual environment. No one participant was immersed more than the others and no participant emerged as a leader. Group accord matched the results of Study 1.

Study 3 - In the final experiment, the two participants were physically located in London and Nottingham, England, and one in Greece. One participant was immersed more than the others via HMD. This was required to study whether use of a wide area network would have any effect on immersion. Dependent variables were self-reported presence as indicated via a questionnaire. Co-presence was, also, assessed via questionnaire. Group accord was measured similarly with a questionnaire. To account for a confound associated with personality, another question was added to control for anxiety effects resulting from the study.

The results from a statistical analysis of the surveys found a positive correlation between presence and co-presence. Immersion had little or no effect at all on reported presence. Individual accord was positively correlated with co-presence. No clear pattern of leadership behavior emerged with respect to immersion. However, it was noted that the green participant (Greece) almost never emerged as the leader. This was likely a result of the wide area connection being 3-5 times slower than the network speed between London and Nottingham. Researchers, also, found that the immersed person with the HMD tended to emerge as the leader a significant amount of time. Steed, et al., hypothesized that this was the case because he was presented with superior navigation metaphors (walking and moving naturally in space) and, therefore, he managed to reach more information about the environment than the others. That person, perhaps for the same reason, felt compelled to be more vocal about his findings and felt obligated to provide his teammates with the best information possible. Consequently, the same person was perceived as someone who knew what he was doing i.e., someone who was more likely to be perceived as a leader (talkativeness did correlate highly and positively with leadership).

e. Summary

Many of the studies that we mentioned in this section found a number of factors believed to predict or, at least, to correlate with leadership. For instance, the U.S. Marine Corps publishes their fourteen leadership traits. Further, Lieutenant General Ulmer's article in Armor magazine distills the leadership behaviors from four division commanders with combat experience in Iraq down to a list of thirty behaviors (Figure 1). Also, in Lieutenant Colonel Donnithorne's book, *The West Point Way of Leadership,* he mentions nine leadership characteristics. Bartone, et al., and Popper established a number of predictive leadership measures.

A simple comparison yielded an interesting juxtaposition of traits/behaviors in Table 1 from Lao-tzu to modern military perspectives. The idea behind this table is to create a quick mechanism to compare each of the studies/lists mentioned in this work to identify if there is agreement between the different methodologies to identify leadership qualities (for either identification or predictive purposes). After the chart was established, we removed rows containing only one item. The purpose of this was to demonstrate agreement between the methods -- not to list each line item represented.

Table 1. Comparative Analysis of Previously Mentioned Observations & Research

	Lao-tzu	Aristotle	Ulmer	USMC	Donnithorne	Bartone, et al.	Popper
Confident and Calm Under Pressure			◆	◆	◆		◆
Courageous				◆	◆		
Decisive	◆		◆	◆			
Eloquent and Articulate			◆		◆		
Encourages Initiative	◆		◆	◆			
Fair	◆	◆	◆	◆			
Intelligent					◆	◆	
Positive and Enthusiastic			◆	◆			◆
Professionally Competent			◆	◆			
Selfless and Loyal	◆		◆	◆			
Sound Judgment			◆	◆		◆	◆
Trustworthy	◆		◆	◆	◆		

Most of these are a very close match, but there was some subjectivity in the placement and assignment of each leadership trait. Intelligence was not specifically mentioned by Ulmer, nor was it listed among the USMC leadership traits, but, from the other behaviors and traits that were listed, it becomes obvious that this was an important element of the leadership equation. Perhaps, this might be one that the authors believed was innate and individualistic; thus, it could not be acquired or improved upon as the other traits listed in the chart. These findings are interesting for a number of reasons and have obvious implications for military training. The NEOAC is such a simple instrument which could be used during initial military training to establish baselines of leadership potential. Virtual environments might be the next step in the evaluation of a student with respect to his leadership grade. This assumes that the VE was constructed to create situations where leadership could be demonstrated. We believe that additional focused studies should be conducted to confirm if leadership can be predicted based on specific observations of a user's participation in a VE (Steed et al., 1999). Conclusive evidence in this regard could provide the instructors with early indicators of how a student might perform in a real leadership situation. Though researchers are still unable to write a

definitive prescription for leadership, they are, at least, closer to that goal than Lao-tzu and Aristotle were two to three millennia previously. Interestingly, the principles that these two philosophers saw so long ago in the leaders of their day are still both relevant and, in some cases, the same ones that philosophers today use to measure leadership.

2. Decision-Making

Decision-making is an essential part of military operations. Modern scientific research has developed numerous models of decision-making. Military organizations have incorporated some of these elements into their processes as well. The Military Decision-Making Process (MDMP) has been documented to assist military personnel with organizing their thoughts and preparing courses of action. Most recently, military schools have adopted computer-based decision-making simulations as a way to train small unit leaders in the art of tactical decision-making.

a. The History of Military Decision-Making Doctrine

Militaries throughout history have relied upon good decision-making methodologies to implement their tactics and strategies. The U.S. Army Field Manual (FM) 100-5 Operations defines decision-making as a combination of information coupled with use of judgment as an element of combat power. It emphasizes that decision-making requires knowing the following elements: If to decide, when to decide, and what to decide (as cited in Beal, 2002, p. 1). A method of decision-making is a critical skill from the highest echelons within the military establishment to the level of the individual soldier. To make quick course of action decisions, the leader must practice making decisions based on a consistent, logical, and deliberate process.

Carl von Clausewitz, the famous Prussian military strategist of the early 19th century, compares decision-making at the tactical and strategic levels:

> It takes much greater strength of will required to make key strategic decisions than a tactical one. With tactics, the actor is swept along by the moment and feels caught up in a whirlwind so intense that the struggle against it would result in the direst of consequences. With strategy, where everything moves much more slowly, there is plenty of room for one's own misgivings, objections, and ideas - and those of others - and for

> inopportune remorse. With strategy, one does not see at least half the situation with one's own eyes; rather, everything must be guessed at and presumed, which decreases one's level of conviction. As a result, most generals become bogged down with ineffectual fears when they should be taking action. (as cited in Ghyczy, von Oetinger, Bassford, 2001).

Clausewitz clearly states that the tactical leader is required to make decisions faster than a leader at the strategic level. Decisions at the tactical level usually involve close to immediate life or death situations. For the leader at the tactical level to practice his decision-making, he must be in an environment where he must make decisions and experiences their consequences. Tactical decision-making simulations provide both the environment and the consequences for today's military leaders.

b. Decision-Making in Today's Military

Decision-making is not only a concept written about in the historical strategy books, but one that is crucial for victory. Military field manuals, related to strategy and tactics on the battlefield, require good decision-making processes. Chapter 2 of FM 17-15 (1996), describes the concept of military command as having two vital components: decision-making and leadership. Furthermore, the same manual describes decision-making as a conscious process for selecting a course of action from two or more alternatives (FM 17-15, 1996). The importance of decision-making is, also, clearly seen in infantry platoon-level field manuals. FM 7-8, Infantry Rifle Platoon and Squad, states that decision-making in one of the most important skills that a leader can have. Furthermore, it states that the platoon and squad leaders should be tacticians and take the initiative on the battlefield. For them to make sound decisions, they must master knowledge of tactics, techniques, and procedures (TTPs) at the squad and platoon levels (FM 7-8, 2001, Chapter 1).

The Military Decision-Making Process (MDMP) is an expedited logical set of guidelines that is used when there is more time to develop and plan for a course of action. MDMP is a method that can help commanders, and their staffs, to reach logical decisions in a timely manner. The commander, and the staff, determines different

courses of action for both friendly and enemy forces. After this phase, they develop their plan. The steps of the MDMP are contained in Army FM 101-5, Chapter 5, p. 3:

1. Receipt of Mission
2. Mission Analysis
3. Course Of Action Development
4. Course Of Action Analysis
5. Course Of Action Comparison
6. Course Of Action Approval
7. Orders Production

The MDMP is, also, addressed in detail in FM 5-0, Staff Organization, and Operations. It describes the deliberate form of MDMP as both a prescriptive process and an analytical tool (as cited in Van Poppel, 2005). The U.S. Marine Corps has a doctrinal publication (Marine Corps Warfighting Publication 5-1), named "Marine Corps Planning Process, that approximates the Army method contained in FM 101-5.

c. Decision-Making Models

There are many types of decision-making models within civilian and military applications. Military field manuals and civilian researchers perceive decision-making very similarly. They both understand it to be the process of choosing the most appropriate course of action among many. The two models that are most relevant to this work are the rational model and naturalistic decision-making.

Rational Decision-Making: Oxford Business School Professor Loizos Heracleous (1994) explains rational decision-making as choosing the objective among a variety of alternatives. Heracleous also concludes that the applicability of this model is limited to relatively simple problems where objectives are clear, unambiguous, agreed upon, and cause-effect relations are well understood. This definition of decision-making, and the explanation of the rational model, is virtually identical to the definition stated in U.S. Army FM 101-5. Baxter et al. (2004) examined military decision-making and found that it was one of the eight dimensions of tactical thinking. Decision-making is the identification of a feasible course of action (COA) obtained from experience accumulated

in similar situations. Christopher Wickens et al. (2004) consider rational decision-making to be represented by three phases:

1. Acquiring and perceiving information cues relevant for decision,
2. Generating and selecting hypotheses, or situation assessments, about the meaning of the cues regarding the current state relevant to the decision,
3. Planning and selecting the choices to take, on the basis of the inferred state, the costs, and the different outcomes. The three stages often cycle and iterate in a single decision.

Naturalistic Decision-Making: Researchers soon discovered that humans often did not follow rational models for decision-making tasks. Instead, Gary Klein's research on naturalistic decision-making in 1993, proposed that people use heuristic and individual bias from previous similar experiences to make decisions (as cited in Shattuck & Miller, 2006). Naturalistic decision-making seeks to describe how humans actually make decisions in the environment where the decisions would actually be made. Laboratory research of decision-making was considered artificial and ultimately an erroneous way to examine the real way that people make decisions. Furthermore, Christopher Wickens et al. (2004) state that people try to make the best possible decision for their given circumstances and within time limits. Instead of waiting for the very best solution to percolate to the top, they try to find the choice that is "good enough" for their purposes. This shortcut method is termed as "satisficing."

When we look at the military decision-making, we see that field manuals do not only propose the detailed and time consuming process to arrive at a good decision (MDMP), but, also, they promote a method of heuristics to evaluate the situation composed of the following elements: Mission, Enemy, Terrain, Troops, and Time (METT-T). METT-T permits a commander to obtain a relatively comprehensive mental picture of his particular situation without going through the extensive and time-consuming MDMP. The Marine Corps captures this particular concept in Marine Corps Doctrinal Publication 1-3 (Tactics) which states:

> In some cases, speeding up the analytical decision-making process may be sufficient; however, in most cases, intuitive decision-making is needed to generate and maintain tempo. Intuitive decision-making relies on a commander's intuitive ability to recognize the key element of a particular problem and arrive at the proper decision without having to compare multiple options (as cited in Nichols, p. 26).

d. Decision-Making and Simulation

Military organizations recognize that computer-based decision-making tools are important in the training of their personnel. One of the difficulties in acquiring good decision-making skills is that a leader needs to make many critical decisions. However, there may be few of these opportunities. For example, the opportunities to make tactical decisions in combat do not occur that often. The best decision-making environment that can be achieved in training is one that approximates the combat situation as closely as possible. Even training exercises are limited due to time, space, financial considerations, or physical limitations to conduct a large number of trials/runs in a given (usually short) period of time. One way of providing a decision maker with the opportunity to make many decisions is to introduce the use of tactical decision-making simulations (TDSs) in his regular training schedule. This can place a leader at a critical decision point many times. This method allows the leader not only to make decisions regarding how he would proceed with his own troops, but, also, to allow him to view the same situation from the enemy's perspective.

According to retired U.S. Marine Corps Gunnery Sergeant, Paul Nichols (2006), the focus is on enhancing Marines' analytical decision-making abilities. There have been several studies in which scientists evaluated the training effectiveness of a single TDS. In their study, Baxter et al (2004) tried to evaluate how effective a TDS, called Close Combat Marines (CCM), was for the subjects compared to traditional paper-based tactical decision-making games (TDG). They did this study at the USMC Infantry Platoon Sergeant (IPS) Course, Advanced Training School, Camp Geiger, North Carolina. Fourteen USMC non-commissioned officers, who were attending the IPS course, participated in their study. The researchers administered surveys to the students and instructors. They required the students to choose a course of action (COA). Based

on the results of their data analysis, they concluded that the TDS (CCM) was most likely to address the macro-cognitive activities of uncertainty management and team coordination. The TDG better addressed mental simulation and planning. They could not find any significant evidence whether TDG or TDS was effective for training decision-making.

There have been other studies that evaluated TDSs as well. In the Tactical Decision-Making Simulations II report, which was prepared by CHI Systems and Klein Associates for NAVAIR Orlando in 2004, the researchers tried to evaluate another TDS, named Marine Air Ground Task Force XXI (MAGTF XXI). The researchers stated that situational awareness is the foundation for making good decisions. In the beginning of the NAVAIR report, they hypothesized that SA accuracy scores would be higher in the TDG condition than in the TDS condition. This was confirmed by their findings. They, also, stated that follow-on research could investigate the best use of TDSs for producing improvements in SA and in assessing the impact of this training on decision-making.

In their Naval Postgraduate School thesis, Games for Training: Leveraging Commercial Off The Shelf Multi-player Gaming Software for Infantry Squad Collective Training, Nolan and Jones (2005) sought to find out whether the first person shooter games could effectively train squads in collective, leadership tasks, and decision-making. They chose "combat drill" as the task that the experiment subjects would perform because it is a "collective action rapidly executed without applying a deliberate decision-making process" (as defined in FM 7-8, 2001, Chapter 4, p. 1). They concluded that the infantry squads can use commercial off the shelf (COTs) gaming software for this level and type of collective squad training.

Military doctrine and manuals emphasize the importance of leadership and decision-making. Because they believe they are beneficial, military schools have adopted computer-based methods for training their young Commissioned Officers and Non-Commissioned Officers (NCOs). Modern scientific research confirms this notion and presents its own evidence that simulations have a strong role to play in this training

effort. TDSs offer the student the ability to act as if he was leading a small unit in a real environment and present him with numerous opportunities to make decisions in virtual combat.

3. Situational Awareness (SA)

Situational awareness is a concept that has been the center of much academic discussion. To some degree, this is a debate of semantics because most researchers acknowledge that humans have some level of perception regarding the events that are taking place around them and that they use this information to make their decisions. The concept of how SA is defined and measured in teams and in individuals is not only debated in civilian circles, but within military training environments as well. The remainder of this section will be devoted to the discussion of concepts that are related to situational awareness.

a. Definitions of Situational Awareness

Although there have been many definitions of SA, Dr. Mica Endsley's definition and her model are some of the most well known and widely accepted in the field. Endsley defines SA as "knowing what is going on around you" and "consisting of three levels: perceiving elements in the environment within a volume of space and time; comprehending what they mean in context; and predicting their status in the near future" (as cited in Stanners & French, 2005, p. 2). In a technical paper written for the society of automotive engineers, W.L. Hamilton (1987) provides an earlier definition of SA in the military environment as the knowledge of current and near-term disposition of both friendly and enemy forces. The authors of a 1988 technical report prepared for the department of defense focused on four dimensions of SA including spatial, identity, automation, and temporal awareness (Harwood et al., 1988).

b. The Need for SA or the Lack Thereof

SA is essential for good decision-making. A lack of it can have disastrous consequences. Dr. Endsley explains that "...problems with SA were found to be the leading causal factors in a review of military aviation mishaps, and in a study of accidents

among major air carriers, 88% of those involving human error could be attributed to problems with situation awareness" (Endsley, 1999 , p. 1). Furthermore, though some of the aviation mishaps were found to be the result of incorrect action selection, they are actually errors in SA (Endsley, 1999). The author stated that the aircrews made the correct decision based on their mental picture of the situation, but, since that picture was inaccurate, they made erroneous decisions that resulted in the mishap.

The aviation community is not the only group to have suffered from issues resulting from a lack of SA. There have been studies dealing with automobile driver SA as well. Ma & Kaber (2005) conducted a study regarding the effects of an adaptive cruise control (ACC) and use of a cell phone while driving. Half of their participants were required to use cell phones while driving virtual cars in a driving simulation with the use of ACC. The other half-used cell phones, but without the ACCs. The results indicated that use of the ACC system improved SA during the driving task and reduced driver mental workload. The cell phone conversation caused negative effects on driver SA and increased driver mental workload. This study suggests that the introduction of automation in the driving task frees up mental processes that the driver can bring to bear on other driving requirements. Therefore, automobile automation can significantly improve driver SA. The implication of this study is that a lack of SA while operating a motor vehicle can increase the frequency of accidents.

Not only is SA essential in aviation tasks and while operating automobiles, it is, also, an important part of ground combat. Mathews et al. (2000) states that SA is a fundamental aspect of infantry operations and discusses a systematic approach to determine infantry SA requirements. According to these researchers, the emerging infantry doctrine and non-linearization of the modern battlefield requires soldiers to quickly assess and act based on their available information. Finally, this study emphasizes that the ground military troops need good SA if they are to be successful on today's complex battlefield.

c. Endsley's Model And The Levels of SA

Endsley and Garland (2000) defined SA in a three level model:

Level 1 - Perception: This is the foundational level on which the two subsequent levels rest. The perception of the status, attributes, and dynamics of the elements in the environment is the very first level of SA. Without basic knowledge of the environment, it is highly possible that the person will have an incorrect picture of his environment, which could lead to disastrous consequences.

Level 2 - Comprehension: SA cannot be confined only to one's perception of the world. It goes beyond simple awareness of the environment. This requires integration of different information from multiple sources. This level, also, requires mental processing of the information by choosing the right components based on the goal.

Level 3 - Projection: This is the third and the highest level of SA. Level-3 SA is defined by Endsley as the ability to project forward from current events and to anticipate future occurrences. She emphasizes that this level allows the person to make rapid decisions by using his expectation of what might happen in the future. Figure 3 is Endsley's Model of Situational Awareness in Dynamic Decision-Making in which all levels of SA are components.

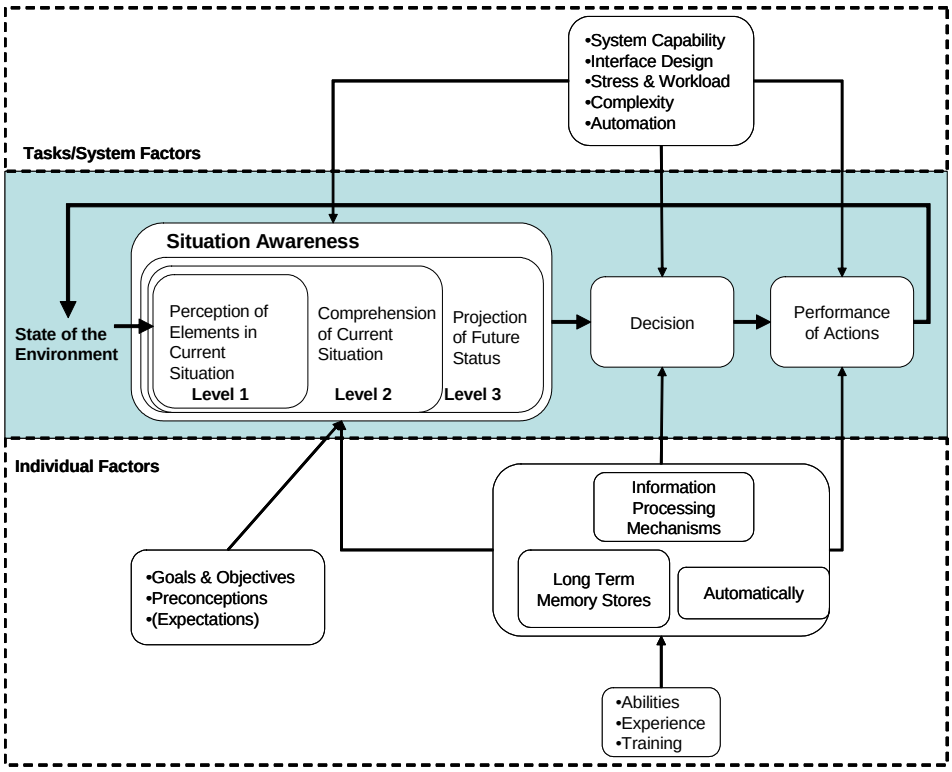


Figure 3. Model of Situational Awareness (After: Endsley and Garland, 2000)

In their book, *Human Factors Engineering*, Wickens et al. (2004), state that selective attention is an important element in perception and that projection heavily depends on working and long-term memory.

d. SA and Decision-Making

Endsley and Garland (2000) believe that SA is only a component of good decision-making as seen in Figure 3. They emphasize that SA is a precursor to decision-making and point out that there are other factors that influence SA and that can contribute to a good performance. Endsley (1995) explains that making an incorrect decision is possible even though there is perfect SA. Endsley gives an example of a military commander who has a perfect SA of the battlefield, but selects an inappropriate course of action (as cited in Endsley and Garland, 2000).

Dr. St. John et al. (2000), in a U.S. Navy SPAWAR technical report, explains the relationship between SA and tactical decision-making after they conducted two experiments. The subjects in their study were 28 Marine Corps officers and senior enlisted staff non-commissioned officers.

In their first experiment, they hypothesized that "a good graphical representation leads to a better recall of enemy intent and future position than either textual or implicit representation of that information on a battlefield map" (St. John et al., 2000). The researchers provided this information to the participants under two methods. Method 1 was text descriptions of unit locations, size, and direction of movement. Method 2 showed participants representations of enemy location, size, and direction of movement on a high quality military grid map. After some time, the subjects were required to provide this information back to the researchers. The researchers did not find any statistical significance between the two methods of depicting the basic SA information.

In their second experiment, they tried to answer the question: How does uncertainty affect tactical decision-making and how can its adverse effects be minimized or eliminated? Their hypothesis was that increasing situation uncertainty would lead to a more wait and see approach and, consequently, to a slower decision-making process. Furthermore, they thought that the effects of situation uncertainty would lead to longer decision-making times in inexperienced subjects versus experienced ones. Contrary to their expectation, rank and military experience did not predict the quality of their decided courses of action. The amount of experience that subjects had within a Combat Operations Center (COC) was the deciding factor with regard to the quality of their decided course of action. Their observation was that the participants who had less COC experience chose the wait-and-see approach, while the participants with more COC experience were found to be less affected by the uncertainty in the scenarios.

Stanners and French (2005) did a study on the relationship between SA and decision-making. The number of participants was 24. They decided to use a commercial off-the-shelf first person shooter computer game called *Operation Flashpoint*. Participants were provided with a summary of a combat situation. The

researchers assessed SA by using the direct questioning technique (DQT). This consisted of asking questions to the participants at natural breaks during the game. SMEs were responsible for assessing decision-making among the participants. The SMEs scored the participants as optimal (5), average (3), or poor (1). This is a typical 1-5 Likert scale. They used the action-inference decision tree (AIDT) to cover every possible action that a participant could take. The SME plotted the participant's decision on the chart. They found a positive correlation between SA and decision-making, as well as, SA and planning.

e. Measuring Individual SA

The scientific community has different opinions regarding the exact method that should be used to measure SA and, as a result, they have developed several different ways to measure it. Salmon et al. (2004) classified different techniques to measure SA:

- On-line freeze techniques. Direct measurement of the subject SA. Situational Awareness Global Assessment Technique (SAGAT) and Situational Awareness Rating Technique (SART) are the techniques that are widely validated.
- Real-time probe techniques. There is no freeze of the task. This technique involves SA related queries during the task.
- Self-Rating techniques. After the task, the subjects rate his/her own SA on a scale.
- Observer rating techniques. There are subject matter experts (SMEs) who evaluate the SA.
- Questionnaire techniques. SA-related questionnaires are provided for the subjects after the task. Then, the subjects evaluate themselves.

SAGAT is the technique that was developed by Mica Endsley. Endsley et al. (2000) explains that the SAGAT procedure involves stopping exercises and simulations in a variety of ways; then, asking the participants questions that are designed to assess the individual's SA. The questions incorporate perception, comprehension, and projection. Another popular measurement technique is SART. SART is generally used in the

aviation society. Endsley (1998) explains that SART provides subjective ratings of SA by the operator. SART ratings are highly correlated with operator workload and performance.

The various SA assessment techniques can all yield valid results. The proper tool/technique is a function of the type of task and the domain of the users involved. Based on the specific situation, the researchers choose the technique.

f. Measuring Team SA

Many research teams and organizations have conducted experiments on measuring individual SA in military environments. These evolved into a need to measure SA collectively within a team. Salmon et al. (2004) did a study focused on finding the best measurement device for SA in a Command, Control, Computers, and Communication (C4) environment. They indicated that the existing techniques used to assess individual SA were adequate. However, there was a need for some mechanism to assess team SA. One of their conclusions was that a combination of techniques, such as the Situational Awareness Rating Scales (SARS) and SAGAT, would be a suitable way of assessing SA for C4 teams. Another study, entitled *Development of a Metric for Collaborative Situation Awareness* (CSA), focused on military SA. In this study, Redden et al. (2005) used PC-based game scenarios, which focused on actual military operations in urban terrain (MOUT) as their platform for the study. Their goals were to:

- Design MOUT scenarios to elicit realistic communications and tactics,
- Develop a script-based assessment of the team member's and the team leader's SA at the three levels of SA,
- Manipulate communication structures,
- Assess the degree to which individual SA and the communication structures affect the SA of the leader.

The three-person teams used in the study played the roles of infantry squad leader and two subordinate team leaders. The researchers measured SA levels for both the team and squad levels. The questions that the researchers used to evaluate SA were designed to distinguish between the three levels of SA (Perception, Comprehension,

and Projection). The questions focused on the squad and fire-team levels of leadership. This study is a good example of how to look at team CSA using a simulation or a game-based environment.

We can see that situational awareness is a vital component of decision-making within military aviation, as well as, for military ground training and combat. The military has several decision-making tools that might, also, be used for evaluating SA.

4. Tactical Decision-Making Game (TDG)

> The tactical decision games (TDGs) are situational-based scenarios where individuals are required to exercise mental agility to meet the demands of the situational stimuli while implementing a problem solving solution. The TDG can range from paper media to a situation given orally to Marines by a seminar leader or facilitator. (Marine Corps Institute).

Military organizations have been using TDGs for hundreds, even thousands of years. One of the earliest references to a TDG was from the famed Chinese general and theorist, Sun Tzu. "This technique (TDG) can be traced back at least to...Sun Tzu, who was advocating their use more than 2,500, years ago." (U.S. Marine Corps, 1989). More recently, the Prussian state in the 1800s was noted to be using TDG. Many Prussian military leaders at the start of the 19th century believed that war was coming soon. Their military was faced with the monumental task of the state's security and was required to quickly develop its officers and enlisted personnel. J.T. Gatto, in his 1991 book entitled *The Prussian Connection,* stated that the Prussian Army had to "prepare hard in peacetime to be ready when war began. From the very beginning of a Prussian (later German) cadet's career, TDGs were used to sharpen the students' decision-making skills and to provide a basis for evaluating them on their character" (as cited in Vandegrift, 2006, p. 32).

Modern TDGs are usually conducted with paper and pencil around a sand table or some other terrain model. They can, also, be conducted without a terrain representation. To improve situational awareness, the modern military uses TDGs primarily to build tactical decision-making skills and to assist military personnel with critical thinking (Gonsalves, 1997).

Some benefits of TDGs include:

- Improving pattern recognition skills,
- Exercising the decision-making process,
- Improving and practicing communication skills,
- Increasing leadership potential.

Some limitations of the TDG are:

- Representing a snapshot in time,
- Allowing participants to make only one move,
- Simulating operating environment is difficult - impossible to simulate the friction and uncertainty of the operating environment,
- Working for units no larger than company level,
- Applying to special operations is difficult (Marine Corps Institute, 1989).

5. Tactical Decision-Making Simulation (TDS)

As computer technology became more prevalent and more powerful throughout the 1990s, TDGs began to give way to computer-based tactical decision-making simulations (TDSs). TDSs kept the basic premise of the TDG, but integrated computer technology with artificial intelligent agents. This new approach allowed the Marine, or team of Marines, to fight against the system that had an artificial intelligence component. Historically, the military has been one of the early adopters in the use of computer-based simulations applied in a training environment. However, there is still much to learn about how to best use them in a military training curriculum.

Over the last two decades, all branches of the military service have begun to express more interest in using simulation to support the training of ground officers. Desktop simulations and digital game-based technologies have earned much attention for their potential as training interventions. Supporters view the sensory (predominantly visual and auditory) interactivity of the technologies as powerful means of fostering the development of cognitive skills relative to the task.

Ground officers work in environments that are very fluid and dangerous; their tasks are less procedural and more subject to changing situations. TDSs allow them to experience near real-world tactical situations that offer the opportunity to make numerous

decisions without the risk of harm. Additionally, unlike a real-world training scenario, these decisions, and their consequences, can be replayed many times to the decision-maker as a training tool. This can illustrate what went right and what may have gone wrong.

The research on TDSs has mostly dealt with overall teaching methodologies involving simulation, computer-based training, and commercial games used for training. The preponderance of the scientific literature on this subject has been devoted to macro-cognitive activities, decision-making, situational awareness, and training effectiveness. Researchers have focused on dealing mostly with overall learning and retention provided by the simulation (Baxter, Ross, Phillips, Shafer, and Fowlkes, 2004) and (Fowlkes, Cohn, Jones, Hafich, Nichols, Woodman, and Bushika, 2005). One area, in which many of these studies are lacking, is an emphasis on learning to use (operate) particular simulations.

Some simulations require many hours to bring students to a level where they can operate them. This phase is the "*learn the system*" phase, which is an essential piece of the overall training strategy. Since military training time is always limited, it is vital for students to learn how to use the simulation in the shortest period. This is so that they can begin progressing quickly toward the mastery of their learning objectives, instead of hunting and pecking their way through the session. This wastes time and resources. A lack of meticulous work in this area (examining preliminary training needs) could cause the introduction of TDS technology that does not capitalize on its training potential.

In their Naval Postgraduate School thesis on leveraging commercial off the shelf games for use in military environments, Nolan and Jones (2005) conducted several training sessions. Initially they used the lecture method and, to a lesser degree, hands on computer control of their avatar (the virtual representation of a human within the game):

> We initially felt that the training we provided and their (the student's) exposure to the game environment would be sufficient. Survey results…indicated that the participants felt that there was too much lecture and not enough hands-on training…Based on this feedback, we altered our training for the remaining two pilot studies. Our familiarization and training program evolved to a much shorter classroom presentation

> followed by a group, hands-on training session in the virtual environment….The positive results from these pilot studies led us to use this ads our training and familiarization technique during the experiment conducted at Ft Benning, GA (Nolan & Jones, 2005).

Based on the previous research, we can see that a variety of methods have been used to teach participants to use a simulation. However, the most effective one mentioned by these researchers is one where there is a short lecture phase preceding a "hands-on" training phase. This is where participants actually operate the simulation on their own.

6. Comparing TDGs and TDSs

The TDG and the TDS have many similarities, but there are a number of differences as well. Baxter et al. (2004) conducted a study that assessed the CCM TDS against the paper based tactical decision game (TDG). The researchers had fourteen participants from the Infantry Platoon Sergeant Course taught at the Advanced Infantry Training School at Camp Geiger, North Carolina. They used a within-subjects design, where all participants went through both the TDS and TDG. The researchers gave surveys to the students and instructors before and after the TDS and the TDG sessions. In the end, the researchers concluded that TDS was most helpful for developing the students' mental coordination, mental simulation, and uncertainty management tasks; TDS was observed to be more helpful for planning. The researchers, also, examined decision-making and its relationship to the TDG/TDS. However, that proved inconclusive because neither TDS nor TDG was a recommended teaching method. More research is definitely needed to explore the ability of TDG and TDS to train and evaluate the skills that they are believed to train.

7. Close Combat Marines (CCM)

The Marine Corps has been leveraging aspects of digital-game based methods and inserting them into the tactical decision-making simulations (TDSs) to supplement existing training (Baxter, Ross, Phillips, Shafer, and Fowlkes, 2004, p. 1). The Marine Corps currently uses a TDS named Close Combat Marine (CCM) at various leadership and tactical training schools. This TDS is a top-down view of the battlefield and was

designed to develop the tactical decision-making skills of entry-level officers. The CCM used at the introductory infantry training school in Quantico, Virginia, is called The Basic School (TBS). TBS's follow-on school for advanced infantry tactics is the Infantry Officer's Basic Course (IOBC), also located in Quantico, Virginia, uses this product as well. CCM is not exclusively used for training U.S. Marine Corps officers. Enlisted Marines, also, gain exposure to this tool at the Platoon Leader's Course (PLC) for non-commissioned officers (NCOs) at Camp Geiger, North Carolina (Nichols, 2006).

CCM has a series of setup and information screens as seen in Figure 4

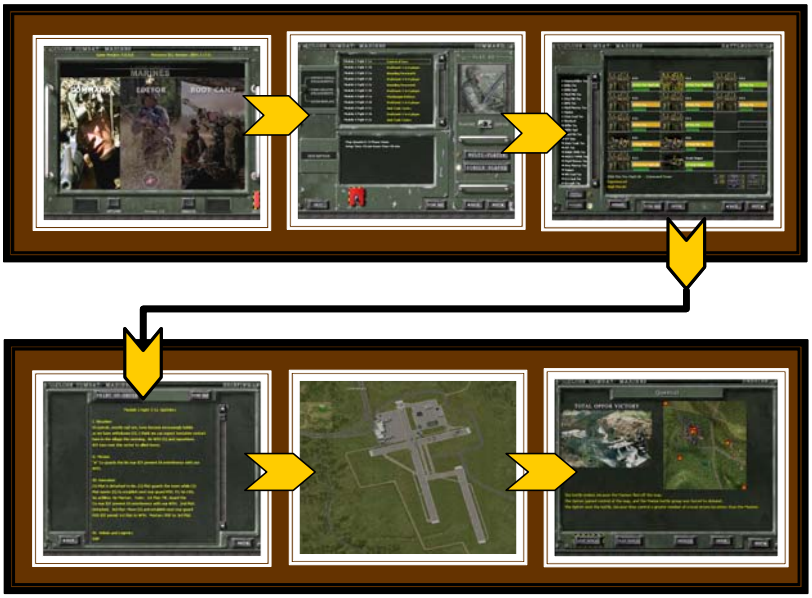


Figure 4. CCM Startup, Mission, and Results screens

The final screen displayed captures the results from the scenario and displays these to the TDS participants. Each CCM scenario comes with a recommended number of troop and vehicle assets. Each scenario is provided with two operations' orders, one for the offense, and one for the defense. Finally, CCM provides a specific terrain that is unique to the scenario in which the teams engage one another and attempt to accomplish their missions.

III. EXPERIMENTS

A. EXPERIMENT 1 - PRE-TRAINING STUDY LEARN THE SYSTEM

1. Introduction

Based on the findings from our literature review, we believe it was important to establish a base of knowledge among our participants. It is, also, important to provide them with an opportunity to learn how to operate the TDS system that will be used in our second study. To accomplish this, we designed a study to explore preliminary training approaches to see which method brought the users to an acceptable level of competency.

In a U.S. Army Command and General Staff College Master's Thesis entitled, *The Application of Off-the-Shelf Military Simulations to Train Decision-Making and Teach Tactics*, Shoemaker (2003) analyzed several different computer simulations. His study required officers to evaluate these simulations on their own time and report their findings back to him based on a template that was provided. While the specific results are interesting, they are not relevant to our work. What is interesting is that no preliminary training was provided at all. The officers were simply given the scenario and told to figure it out. Shoemaker reports that there was a variance of over four hours in the lengths of time that it took for each officer to evaluate the simulations (Shoemaker, 2003). This report asserts that, given no initial training on how to best interact with the simulation, wide variations are possible in the lengths of time for a student to become familiar with a system or tool. It is likely that the time to learn to operate a system effectively is highly variable. It is, also, likely that this time period will considerably depend on the type of system that needs to be used in the study.

In our initial study, we analyzed and identified a "best practices" approach to introducing to users a simulation called Close Combat Marines (CCM). Though CCM has been used as a training tool for approximately ten years in the U.S. Marine Corps, there is still a question about the best way of introducing it to new users. The intent of this experiment was to explore two issues: Firstly, the amount of time needed to learn to operate the simulation and, secondly, the best method for bringing a participant with no

experience with tactical decision-making simulations to a place where he would be competent and able to participate in initial TDS training. Additionally, we used this experiment to evaluate their experimental methodology to gain experience going through the institutional review board (IRB) process, experience system hardware and software setup, and practice the management of all participants throughout the entire process.

2. Procedure

We provided a very short (no more than five minutes) verbal explanation of the overall experimental scenario. The three methods in which the students participated were:

- "Boot Camp Only" - The manufacturer provided a Boot Camp scenario designed specifically to train a user to operate the simulation;
- "Memory Sheet Only" - A memory sheet that outlines all functionality of the simulation controls and describes the various parts of the screen in terms of menus and displays;
- "Boot Camp Plus Memory Sheet" - A combined approach of the Boot Camp and the Memory Sheet. Our null hypothesis was that there was no difference between any of the three training methodologies.

Participants engaged in and were evaluated on only one of the three above scenarios necessitating a between-subjects design. The following research questions were central to this investigation:

- What is the best method to pre-train users to operate CCM effectively on their own?
- Should this simulation always be used in a controlled instructor-led environment or should the students be allowed to explore and learn on their own?
- How much simulation time is needed to accomplish this prior to the start of the actual training, i.e., how long should the introductory training sessions last?
- How many training sessions are necessary before the user is ready for a real TDS training scenario?
- Is a single training methodology adequate or should a combination of methodologies be used?

Through this effort, we sought to obtain an improved set of introductory training approaches that will be incorporated into a future follow-on study.

Ho (Null Hypothesis) = There is no difference between the abilities of the three methods.

Ha (Alternative Hypothesis) = There is some difference between the three methods with respect to the number of overall mistakes that each participant will make. We chose an $\alpha = 0.05$ as the significance criteria whether to reject the null hypothesis.

3. Method

a. Participants

The participants were all students of the Naval Postgraduate School (N=12), but ranged from among three different academic curricula. There were nine participants studying Human System Integration (HSI); one in Systems Engineering (SE); and two from the Modeling Virtual Environments and Simulation (MOVES) program. The HSI program is considered non-technical and the SE and MOVES degrees are both technical. All twelve participants were U.S. Naval officers (9 males and 3 females). Participants were randomly assigned to the three groups. A 3-block design was used to ensure even distribution to assigned groups. We, also, collected other demographic information, including age, dominant hand, and total time in service. Participants were all treated in accordance with ethical standards established by the American Psychological Association. Further, our study design was approved by the IRB committee at NPS. The IRB paperwork is included in Appendix B.

b. Apparatus

This experiment was conducted in the Human Systems Integration Lab (HISL) at the Naval Postgraduate School, Monterey, California. The layout of the space used during this study can be seen in Figure 5.

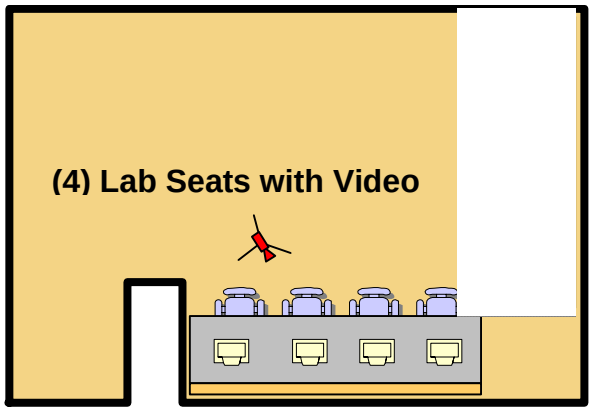


Figure 5. Experiment 1 - Lab Setup

We used four computer desktop workstations consisting of a CPU (Pentium 4), 19 inch monitor, a standard U.S. English keyboard, and a mouse. All of these workstations were wired into the schools network and had CCM installed on them. We used a Canon Digital Video Camcorder, with wide screen recording and 10x optical zoom, to record the screen that the participants were using throughout their test scenario. This camcorder captured audio of the participants for use in the verbal protocol analysis. Due to scheduling conflicts with other classes, we were only able to run one participant at a time through the experiment. For a single participant, we used two computers. On one computer, we had a standardized PowerPoint presentation that provided instructions specific to each of the three different training methodologies. On the other, they used CCM for the training and testing phases of the experiment.

c. Procedure

This study was a between-subjects 1x3 design. The independent variable was the method of training and the dependent variable was the number of mistakes participants made (based on analysis of their 'think aloud' protocol and the analysis of the audio/video recordings of their test sessions). We conducted the audio/video analysis jointly.

The experiment lasted approximately 50-60 minutes for each participant. Upon arrival at the lab, participants were administered a survey that took demographic

information. Additionally, we asked the participants about prior experience with CCM or other military tactical decision-making simulations. The survey required students to disclose their level of experience with commercial computer games and a number of other variables relative to their professional expertise. All participants received the same questionnaire, basic introduction to the experiment, and an overview of CCM. After this was completed, the participants were assigned to one of the three groups (we did not disclose the purpose of the experiment).

(1) "Boot Camp Only." The first group's training scenario task was to learn to use the simulation only by exploring and going through the developer's installed Boot Camp training. This segment of the CCM system was specifically designed by the simulation developers to provide new users with an easy way to learn how to move, shoot, issue orders, gather information regarding the health and welfare of their teams, as well as, to generally navigate within the virtual environment. No training aids were provided to the Boot Camp group.

(2) "Memory Sheet Only." Group 2's training task was to learn to use the simulation by entering into and playing one of the scenarios provided with CCM. The users used CCM and were expected to learn its functionalities by using the system. Each person in this group was provided with a memory sheet that included all commands that they would need to operate CCM during the test phase (this sheet was created by summarizing the material from the CCM User Manual). The article, "Utility of Game Instruction" (Chen, 2003), inspired the use of a memory sheet.

(3) "Boot Camp & Memory Sheet." The training method used with Group 3 was to use a combination of the Boot Camp and the Memory Sheet.

The time that subjects spent in each condition varied, to some degree, between participants because participants in training methods "Boot Camp Only" and "Boot Camp & Memory Sheet" were somewhat controlled by the sequential nature of the Boot Camp. The Memory Sheet Only method was much more free-form. Participants spent less time in this section of the experiment as they seemed eager to get to the test phase. All training sessions lasted no more than 20 minutes. If students expressed

confidence in their ability to operate the simulation prior to their 20-minute training session being completed, they were allowed to begin the test scenario at that time. All test scenarios lasted no more than 25 minutes. We stopped the scenario if the participant had not received a Mission Accomplished, or a Mission Failure notification by that time. Each participant went through the same test scenario "Module 3 Fight 3-1a Machine Gun Defense." Due to their actual performance during the scenario, the amount of time could be less than 40 minutes if the participant's military forces called for or were offered a truce, were judged as absolutely victorious, or were annihilated by the artificial intelligence present with in the CCM system.

We digitally recorded all sessions and required that participants verbalize their thoughts as they made their way through the instructions. They were asked to do the same during the actual use of the simulation during the test phase. This procedure was necessary to capture each participant's intentions and to compare what the participants intended to do with what they actually accomplished. We, also, compared these results with information obtained in the *Pre-TDS* survey. Upon completion of their test session, participants were administered a *Post-TDS* survey in which they entered self-reported values to determine whether they felt they had learned specific CCM controls throughout the experiment.

After the participants had departed, we reviewed over four hours of video/audio recordings and analyzed those capturing four different types of participant errors. We, also, conducted an overall assessment of their simulation strategies with respect to how they used the simulation. This was not an assessment of their tactical infantry decision-making prowess. Rather, it dealt strictly with the nature of the ability to control different aspects of the simulation and to get the information that they needed to make decisions. The most important factor that we analyzed was the participant's ability to accomplish what he intended to after completing his particular method of training.

4. Results

Our primary focus was to determine which of those three training methods proved to yield the least errors during the test scenario. In Table 2, we summarize the results of a

descriptive analysis of the methods. The "Memory Sheet Only" group yielded the fewest total errors on average between the groups at 9.75. They, also, had the fewest errors when considering Error Factor at 2.6.

Table 2. Summary Statistics

	Boot Camp Only	Memory Sheet	Combination Boot Camp & Memory Sheet
Total Errors (Mean)	14.25	9.75	18
Total Errors (Std Dev)	10.59	6.39	4.83
Error Factor (Mean)	6.18	2.6	9.85
Error Factor (Std Dev)	6.05	1.97	6.97

Error Factor = Total Errors/Instructor Evaluation

Total Errors is a raw score that resulted from the simple tabulation of errors that the participants made during their testing phase. This, however, proved to be somewhat misleading because some participants were much more active in giving orders to their troops, telling them to move, shoot, ambush, and defend many more times than other participants. These active participants not only gave many more orders, but, in doing so, increased their chance of making errors. Consequently, we decided to assign a score that would take the activity level of the participants into account. We then divided the Total Number of Errors by this score, which resulted in the Error Factor.

Inferential statistics yielded no significant difference between the three training methods. We used an F-Test (ANOVA) to test our hypothesis. This resulted in $p = 0.3563$ for total errors and $p = 0.2241$ for Error Factor. Neither of these is sufficient to reject our null hypothesis (Ho = No difference between any of the methods).

In addition to the primary hypothesis tests for the overall study, we did find some other interesting results. The participants who had a high level of previous commercial video game experience made significantly fewer errors. The sex of the participants, also, proved statistically significant: Males performed better than females. Finally, there was a significant result between gaming experience and sex indicating that males spent more

time playing video games than females. However, this study only had twleve participants (3 were female) and this low number could have significantly affected the results. (Detailed statistical output is provided in Appendix E at the end of this document).

5. Summary

The analysis of the data collected during the study led us to conclude that we were unable to reject our null hypothesis. However, there were other interesting findings that arose from a more detailed analysis of our data with respect to how other dependent variables influenced total errors and total errors with factor. One interesting finding, that caused us to come up with the factor in the first place, was that female participants were making very few errors. On the surface, it appeared that they were performing almost flawlessly. Upon scrutiny, however, the reason that so few errors were made was because very few commands were issued. They issued far fewer commands than males and, therefore, made fewer errors.

There was one critical piece of data that we believe could have had significant influence on the total number of errors. However, the survey that solicited this information was ambiguous and confusing and was, therefore, removed from consideration. This variable was total amount of video game experience. It was not asked in terms of a single metric, such as number of hours/week. The question was structured in such a manner that the participants would likely not know whether they were answering in hours/day, hours/week, hours/month, or hours/year. This produced wild variations in the data from this question and, even with extensive effort to salvage the data; we decided that it would be too misleading to report it.

It is interesting to note that the Memory Sheet method yielded the fewest errors in both the Total Error score, as well as, the Error Factor. The Memory Sheet method was the method that allowed the participants to engage in a real scenario versus going through the simulation developer-provided boot camp. We noticed that when the memory sheet was provided in methods 2 and 3, it was mostly unused by participants. After the scenario, many of the participants mentioned they totally forgot the memory sheet as soon as they started taking fire from the enemy. We believe that the memory sheet was

mostly irrelevant to any learning that took place. Further, we believe that the Memory Sheet Only method was the best method for training because it most closely aligned with how users would use the simulation during the test scenario. They were required to issue orders, view toolbars, and assess their teams in exactly the same manner that they would be required to during the test phase. In effect, they were practicing how they would use the simulation. This important training concept was not present in either training method one or three where the boot camp was the primary instructional tool.

Based on the information obtained in this study, we can offer preliminary answers to our research questions:

(1) What is the best method to pre-train users of the TDS to operate it effectively on their own? The answer to this question was inconclusive based on our findings.

(2) Should this simulation always be used in a controlled instructor-led environment or should the students be allowed to explore and learn on their own? We do not believe that the former should always be the case. We found that instructor-led training would be beneficial only as an introduction to the TDS itself. This should be very brief. After that, the student should be placed in front of a computer with the TDS installed and allowed to go through a simple module, such as Module 1 Fight 1-1a, Machine Gun Defense. The instructor would be either beside or behind the student to provide immediate answers to the student's questions on the conduct of the TDS. This approach allows the student to explore the simulation scenario and forces him to use as many resources as possible to accomplish his mission.

(3) How much simulation time is needed to accomplish this prior to the start of the actual training, i.e., how long should the introductory training sessions last? The questionnaire results varied widely from "weeks" to "another 10-20 minutes." The latter is probably closer to the actual answer. We believe that the absolute lack of prior gaming experience from the participant, who stated "weeks" would be required to gain proficiency, was exaggerating due to obvious frustration with his lack of understanding and ability to accomplish his intentions throughout the test phase.

(4) Is a single training methodology adequate or should a combination of methodologies be used? We believe that a combination of methodologies should be used. Users should be introduced with a brief overview of CCM via a lecture method accompanied by several carefully crafted PowerPoint slides depicting images of the TDS in various stages. The various screens could be introduced along with the overall goal of the simulation. This should last no more than 5-10 minutes. The learning process should consist of an instructor taking questions, but getting the users behind a station as quickly as possible. It is important to introduce them to a simple scenario and let them explore. This provides them with expert guidance and answers to their questions as they arise.

(5) How many training sessions are necessary? On average, participants stated that only 1 - 2 sessions would be required to master the basics of operating the CCM controls. We agree with this estimate because the participants' opinions were confirmed by our analysis of the data.

One consideration for future work might be to examine some elements of personality, such as extroversion and openness to see if they are influential on learning to use the controls within a TDS. We were struck by how some participants were very timid with the interface and consistently stated how unsure they were of what to do and how to do it. Others took control immediately and began to issue orders to CCM teams in a chaotic and haphazard way, even telling friendly teams to fire on other friendlies. There was no comprehension about who was who or what the overall goal of the scenario was (even though it had been explained in great detail during the scenario setup phase).

The results from the experiment were very influential when we designed experiment 2. We drew on lessons learned to develop a brief instructor-led introduction to the TDG/TDS and what could be expected in each session. We, then, allowed the students to engage in their particular roles as quickly as possible. We remained close by to answer questions. This was the intent of session 1 in both the TDG and the TDS.

B. EXPERIMENT 2 - PILOT STUDY EVALUATING LEADERSHIP, DECISION-MAKING, AND SITUATIONAL AWARENESS WITH TDG AND TDS

This section describes our second experiment where our intent was to examine leadership, decision-making, and situational awareness in virtual environments and how this differed from the traditional TDG training method.

1. Introduction

Tactical decision-making games and simulations have been used for some time in the training of ground officers, but to what extent they could be used to evaluate leadership, decision-making, and situational awareness, is largely unknown. Some studies have explored decision-making and situational awareness with respect to TDSs, but even fewer examined the leadership question. The TDG has been used by professional military schools training junior commissioned officers and non-commissioned officers. This training method has been proven effective in evaluating decision-making based on the evaluations of subject matter experts. The Tactical Decision-Making Simulation (TDS), on the other hand, has only recently been introduced in some of these schools. There is very little knowledge about how to implement it, what it can accomplish, and whether or not it can replace or augment the current TDG training regimen.

To evaluate the three characteristics mentioned above, we will use two different training methodologies: TDG and TDS.

- **Ho** (Null Hypothesis) = There is no difference between the abilities of the TDG and TDS to train and evaluate military personnel with respect to decision-making, leadership, and situational awareness.

- **Ha** (Alternative Hypothesis) = There is some difference between the TDG and TDS training methodologies with respect to their ability to train and evaluate decision-making, leadership, and situational awareness in military personnel.

We chose an $\alpha = 0.05$ as the significance criteria whether to reject the null hypothesis. A 2-tailed t-test will be used to determine if the two training methods are different with respect to evaluating/training leadership, decision-making, and situational awareness.

2. Procedure

From Experiment 1, we learned lessons which we implemented in this study. The design of this experiment remained between-subjects. Additionally, we realized that a single training session would not be adequate to build the necessary skill level. Also, it would not be sufficient for participants to demonstrate characteristics of any of the dependent variables (Leadership, Decision-Making, and Situational Awareness). We decided on a single introductory session lasting approximately one hour to teach the TDS participants how to navigate and participate in a typical CCM scenario. The same amount of time was reserved for the TDG group. It was used to instruct them about a TDG session and how to participate in one. Infantry tactics, techniques, and procedures (TTP) instruction was provided to both groups during this first hour (same instruction for both groups). We were aware that unless participants had prior training in infantry TTPs, they would only be able to understand TTP instruction at the most basic level. However, this level was all that was required for them to participate effectively in either the TDG or the TDS groups.

We made every effort to standardize the make-up of the teams in the TDG and the TDS. The TDG and the TDS groups consisted of a total of eight personnel each. Within both groups, there were two subgroups of four participants each. In both TDG subgroups, we assigned one of the four to act as the platoon leader; with the remaining three to act as squad leaders. Likewise, in the TDS subgroups, there was one platoon leader and three squad leaders. All participants functioned in their assigned roles throughout their sessions.

The remaining four sessions were split evenly between offensive and defensive scenarios. The CCM software comes with a number of prepackaged training scenarios that allow for individual or team-on-team modes. The team-on-team modality was

selected for use in all of the remaining sessions (Sessions 2-5). The same built-in CCM scenarios were used by the TDG group to ensure that the TDS and TDG groups were presented with the same level of difficulty within their scenarios. The CCM scenarios changed from session to session which, consequently, altered the troop mix and terrain. Table 3 identifies which CCM scenario was used in each session and what terrain was presented to the participants.

Table 3. TDG/TDS Sessions and Scenarios

Day	CCM Scenario	Session	TDG		TDS	
			Team 1	Team 2	Team 1	Team 2
	1-1a Town	1	Introduction	Introduction	Introduction	Introduction
	5-1b Town	2	Defense	Defense	Offense	Defense
	5-1b Town	3	Offense	Offense	Defense	Offense
	2-1b Airfield	4	Defense	Defense	Offense	Defense
	6-1b Farm	5	Offense	Offense	Defense	Offense

We collected two types of data: self-reported through questionnaires (pre and post-session) and evaluations by the instructors. Once each session had concluded, the participants were presented with questionnaires. The collected data was used later to determine relative leadership, decision-making and situational awareness scores. Most of these scores were perceived values based on the subjective assessments of each participant and his/her opinion of teammates' performances within each subgroup. Additionally, the instructors evaluated the platoon leaders in each session from both the TDG and TDS groups. It is clear that situational awareness can only be evaluated for the TDS participants. However, based on TDG participants' comments and discussions during sessions, we expected them to have a level of understanding about their teammates' situational awareness. We extracted those SA answers from the questionnaires and used them to determine individual SA for the TDG group members.

The procedure we used to determine SA for each participant was called the Geographical Recall and Analysis of Data in the Environment (GRADE) (Miller and Shattuck (2007)). An example of this tool can be found in Appendix M. In the middle of the TDS sessions, we paused the simulation and evaluated each participant's knowledge

concerning the location, size, and direction of movement of the friendly and enemy forces. We did this by having them draw circles and arrows on a map sheet. We walked between the rooms recording the exact location, size, and direction of troop movement and used this as ground truth. All TDS participant GRADE sheets were evaluated based on this ground truth sheet. Use of this method was not possible for the TDG group because the TDG offers no ground truth to which a comparison can be made.

3. Method

a. Participants

The participants in this study were primarily students of the Naval Postgraduate School (N=16): (3) female and (13) male, ranging from 21 to 43 years old. Within the group of 16, there were two Cadets from the Air Force Academy and one from the U.S. Military Academy. The remaining participants were from three different academic curricula: 0399 (Modeling Virtual Environments and Simulation), 0365 (Operations Research), and 0360 (Human Systems Integration). The HSI program is considered non-technical and the OR and MOVES degrees are technical. The others were military officers ranging in pay grade from O1-O5. Of these, there were officers from the U.S. Navy, U.S. Army, U.S. Marine Corps, and the German Navy. Participants were randomly assigned to the two primary groups (TDG/TDS). These groups did not interact throughout the experiment. Additionally, the TDS and TDG groups were subdivided into two smaller internal groups (TDS Group A & B, TDG Group A & B). We collected other demographic information: age; military occupational specialty; computer, gaming, and simulation experience; total service time; familiarity with infantry tactics, techniques, and procedures; service component; and country of citizenship. The following tables provide a more concise view of our participants' demographics. Table 4 is granular and provides information by subject number on rank, age, time in service in years, and Computer Experience in hours/year.

Table 4. Individual Summary Demographics

General Demographics				
Subject #	Rank	Age	TIS Years	Computer Experience
TDG				
8	O3	27	5	2920
746	O3	32	4	1460
547	Cadet	22	3	3650
261	O4	36	14	1095
432	O4	37	14.33	365
663	Cadet	21	3	1825
517	Cadet	21	3	1460
97	O2	26	4	4380
TDS				
733	O4	34	11	1095
377	O5	43	22.92	2190
343	O1	23	0.92	1825
64	O3	37	14.67	1095
967	O3	30	7.92	2190
784	O3	31	8	365
13	O3	32	8.58	730
537	O3	35	15.92	1825

In addition to these individual demographics, Tables 5, 6, & 7 summarize the participants by TDG and TDS Group.

Table 5. Group Summary Demographics

	Age		Time In Service		Use of Personal Computer	
	TDG Group (Years)	TDS Group (Years)	TDG Group (Years)	TDS Group (Years)	TDG Group (Hours/Year)	TDS Group (Hours/Year)
N	8	8	8	8	8	8
Min	21	23	3	0.92	365	365
Mean	27.75	33.13	6.29	11.24	2144.38	1414.38
Median	26.5	33	4	9.79	1642.5	1460
Max	37	43	14.33	22.92	4380	2190
Std Dev	6.54	5.79	4.91	6.6	1371.79	688.06

We can see in Table 5 that the computer use among the TDG group was higher than the TDS group. The TDS group had more time in service. This, also, indicates that they were, on average, older than the TDG group.

Table 6. Participants with Prior Commercial Video Game Experience

INFORMATION ASKED	TDS	TDG	ALL
Number of subjects having prior experience playing commercial video games	7	8	15
Number of subjects NOT having prior experience playing commercial video games	0	0	0
Number of people who did not respond to this question	1	0	1

We can see in Table 6 that every participant has had some level of experience playing commercial video games.

Table 7. Summary of Commercial Video Game Experience

Subjects Having Prior Experience Playing Commercial Video Games			
Type of Game	**TDS**	**TDG**	**ALL**
First person shooter			
Subjects Responding	5	4	9
Total # of Hours/Year	132	76	208
Minimum	2	2	2
Maximum	96	52	96
Mean	26.40	19	22.70
Standard Deviation	39.63	22.42	31.45
Flight Simulation			
Subjects Responding	1	1	2
Total # of Hours/Year	96	1	97
Minimum	96	1	1
Maximum	96	1	96
Mean	96	1	48.50
Standard Deviation	0	0	67.18
Racing			
Subjects Responding	3	0	3
Total # of Hours/Year	23	0	23
Minimum	1	0	1
Maximum	20	0	20
Mean	7.67	0	7.67
Standard Deviation	10.69	0	10.69
Sports (Football, etc.)			
Subjects Responding	5	2	7
Total # of Hours/Year	367	27	394
Minimum	2	3	2
Maximum	240	24	240
Mean	73.40	13.50	43.45

Subjects Having Prior Experience Playing Commercial Video Games			
Type of Game	**TDS**	**TDG**	**ALL**
Standard Deviation	100.60	14.85	87.40
Puzzle, Card, Board			
Subjects Responding	5	3	8
Total # of Hours/Year	805	774	1579
Minimum	3	2	2
Maximum	730	760	760
Mean	161	258	209.50
Standard Deviation	318.55	434.77	338.40
Strategy			
Subjects Responding	3	1	4
Total # of Hours/Year	200	12	212
Minimum	24	12	12
Maximum	104	12	104
Mean	66.67	12	39.34
Standard Deviation	40.27	0	42.76
Adventure, Fantasy			
Subjects Responding	3	3	6
Total # of Hours/Year	41	1119	1160
Minimum	5	12	5
Maximum	24	1095	1095
Mean	13.67	373	193.34
Standard Deviation	9.61	625.27	441.77
Arcade			
Subjects Responding	2	0	2
Total # of Hours/Year	97	0	97
Minimum	1	0	0
Maximum	96	0	96
Mean	48.50	0	48.50
Standard Deviation	67.18	0	67.18
Other			
Subjects Responding	0	1	1
Total # of Hours/Year	0	1	1
Minimum	0	1	0
Maximum	0	1	1
Mean	0	1	0.5
Standard Deviation	0	0	0

Table 7 shows that participants had the most commercial game experience with puzzle, card, board, and adventure/fantasy type games. Participants demonstrated the least experience with the racing type games.

Participants were all treated in accordance with ethical standards established by the American Psychological Association. Our study design was, also, approved by the IRB committee at NPS.

We performed the role of instructors by providing the introductory training for the study, including the infantry TTP training in Session 1. For Sessions 2-5, we took notes on performance, answered questions, and administered the surveys before and after each session. Additionally, we found, early in session 1 that managing a study of this size between two separate rooms was quite difficult for only two people. Thus, we enlisted the assistance of a U.S. Marine Corps student in the Operations Research curriculum to help with the study's administrative tasks.

b. Apparatus

The lab space was purposefully configured in a way to support the isolation of the two internal TDG and TDS subgroups. Each subgroup occupied either Room A or Room B as seen in Figure 6.

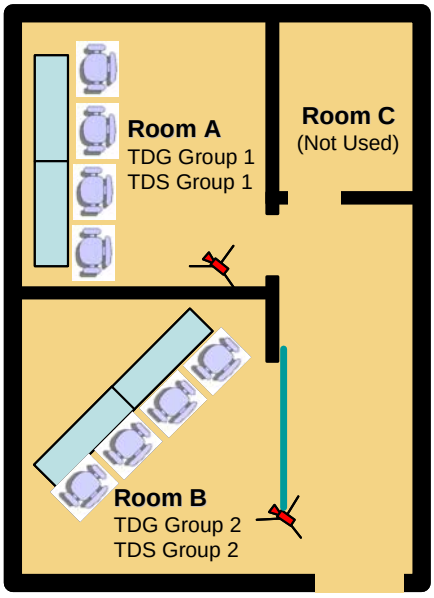


Figure 6. Experiment 2 - Lab Setup

Each squad leader was provided with a Dell Pentium-4M laptop computer (6 all together) with CCM installed on it. The squad leaders used it to execute their own

orders, as well as, to facilitate the commands of the platoon leader. These laptops were part of a closed experimentation network. This network was the basis for the CCM virtual environment that allowed six users (three offense and three defense) to interact with each other relative to the CCM scenario for that session. The environment computers were connected with a 16-port Ethernet Switch using Cat 5 UTP cabling.

For administrative purposes and training, an IBM laptop and an overhead projector were used to demonstrate infantry TTPs and the procedures for participating in both the TDG and TDS sessions. We used two digital camcorders (audio/visual), one in each room, to record participant activities during the sessions. We had multiple copies of a Close Combat Marines Memory Sheet (see Appendix D), the operations order relevant to the particular scenario (see Appendix K), and memory sheet for the offensive and defensive infantry tactics (see Appendix L) presented in the first session. There were white boards in both rooms for the subgroups to diagram their plans and briefs during their group discussion time. We provided scratch paper and pens on all tables for similar planning purposes. We used a twelve-sided die to randomly assign the participants to the groups. This die was, also, used to assign a unique identifier to each participant.

c. Procedure

From within the NPS student population, we acquired a total of 16 participants. Then, we divided them into either a Tactical Decision-Making Game (TDG) group or a Tactical Decision-Making Simulation (TDS) group. The TDS group used Close Combat Marines (CCM). The TDG and TDS groups were further divided into two subgroups containing four subjects each. The TDG and TDS groups participated in the study at different times and on different days. See Table 8.

Table 8. Day and Time for TDG & TDS Sessions

	Week 1			Week 2			
	Thursday	Friday	Saturday	Sunday	Monday	Tuesday	Wednesday
0800-0900							
0900-1000							
1000-1100							
1100-1200							
1200-1300		TDS Sessions 3 & 4					
1300-1400					TDG Sessions 3 & 4		TDG Session 5
1400-1500		TDG Sessions 1 & 2					
1500-1600	TDS Session 1 & 2					TDS Session 5	
1600-1700							

We chose different CCM battle scenarios in the different TDG/TDS sessions. To ensure a strong basis for comparison, our intent was to ensure that both groups received an equal number of scenarios. However, the TDS group mandated that one subgroup be in the offense while the other was in the defense. This was because the teams were fighting against one another in the virtual environment. On the other hand, the TDG group had no virtual environment. Thus, we controlled the nature of the scenario across each session (both subgroups were either on offense or defense). For example, the TDG Session 2 was defensive for both TDG subgroups and Session 3 was offensive for both TDG subgroups. The operation order and overall scenarios used in the TDG were drawn from the TDS CCM.

(1) Tactical Decision-Making Game. The five TDG sessions consisted of one introductory session and four training sessions. In the first session, all TDG participants were provided with instruction on basic infantry offensive and defensive tactics, techniques, and procedures. We explained to them the exact nature of the TDG, how to participate in one, and the exact planning sequence they needed follow to complete the TDG effectively. The memory sheets for both the TTPs and the suggested planning process were available to participants and were distributed onto the tables for both groups.

At the beginning of each TDG session (Sessions 2-5), we read the operation order to the entire cohort in Room B (see Figure 6). The groups were divided

into Group 1 and 2. Group 1 remained in Room B, while Group 2 moved to Room A for planning time. Each group discussed the operations order internally and, then, turned to individual planning. Each individual planned his response to the operation order and formulated his best effort at a course of action. After this phase, the individuals came back together for a group planning session. During this time, a leader was randomly selected to direct his team and to establish the overall team plan. Once each TDG subgroup had its team's plan completed, Group 2 moved from Room B to Room A. Thus, the entire TDG group (8 persons in all) gathered in one room for an After Action Review (AAR). Each team leader, in turn, briefed his team's plan to the entire TDG group. See Figure 7.

TDG Team Planning

TDG After Action Review

Figure 7. TDG Scenario Underway

The instructors and all participants were free to comment on and ask questions regarding the nature of the plans. This applied to why the team decided on a particular course of action. After this phase concluded, each TDG participant filled out a questionnaire related to the session that he had just finished. Additionally, the instructors evaluated the platoon leader's leadership and decision-making performance on a separate evaluation form. The same process was repeated for the remaining three TDG sessions.

(2) Tactical Decision-Making Simulation. Upon arriving at the lab, the participants were divided into two TDS subgroups. The initial training session was the same for the TDS group as for the TDG group except for the hands-on CCM training. The two subgroups (each had four participants) played against each other in the remaining Sessions 2-5. This mandated that one group be in the offensive role and the other group in the defensive. Since the operation orders were different for each group and knowledge about the each other's orders could have potentially compromised critical intelligence, the subgroups were immediately separated so they would not be able to hear each other's internal discussions. The subgroups remained separated in different rooms throughout the entire session (See Figure 6. Lab Space Layout). This technique ensured that each team operated independently and did not have prior knowledge of their opponent's plan.

A platoon leader for each TDS subgroup was randomly assigned at the beginning of each session. That person acted as the leader for not only the planning session, but for the conduct of the entire TDS scenario for his subgroup. The groups were given approximately 3-5 minutes of planning time before they actually started CCM. Once CCM had started, the groups had a short time (2 minutes) to place their troops in the battle space. At this time, we started the actual scenario where each team began to implement their platoon leader's plan within the virtual environment. Each subgroup consisted of three squad leaders sitting at computer terminals while the platoon leader stood behind them, issued orders, and directed the overall team action. The internal CCM system algorithms determined when to end the session based on the number of victory locations that each group controlled and their number of troop losses. In all sessions, the scenarios were allowed to go to completion.

TDS Platoon Leaders Issues Orders

TDS Platoon & Squad Leaders

Figure 8. TDS Scenarios Underway

We monitored the activities of the TDS subgroups seen in Figure 8. One researcher was with Group 1 in Room A and the other was with Group 2 in Room B. Additionally, we acquired the assistance of an U.S. Marine Corps infantry officer. This person assisted us with the administration of the experiment, advice on infantry TTPs, and the discussion in the after action review (AAR) session for both the TDG and the TDS. (A detailed minute-by-minute schedule of the TDG and TDS sessions can be found in Appendix J).

After each TDS session, each participant filled out a questionnaire and entered his/her opinions regarding how their teammates performed on decision-making, situational awareness, and leadership. We evaluated the platoon leaders on decision-making and leadership. Additionally, we used GRADE (Shattuck and Miller, 2007) to evaluate each participant's situational awareness at two points during each session (2-5). However, we were not able to accomplish this as we intended. There were certain days where TDS sessions ended earlier than expected and prior to the full 40 minutes allotted. In cases where this occurred, we had only one GRADE worksheet (see Appendix M) from the participants to evaluate their SA for that session.

4. Results

This section lists results from two different types of analyses from Experiment 2. The longitudinal analysis was descriptive and examined each participant's scores on

leadership, decision-making, and SA across all sessions. The inferential analysis conducted in sections b, c, and d. examined correlations among various factors of interest.

a. Longitudinal Analysis over All TDG/TDS Sessions

For the purpose of preserving our participants' anonymity, we assigned them random subject identifiers which can be seen in all of the longitudinal graphs. We randomized their assignment to groups and their participant numbers to prevent one participant thinking he was better than another participant was, i.e., that a person with the number 1 would be ranked higher than a person with the number 2.

The TDS leaders were appointed early in the scenario while the TDG leaders were appointed in the middle of the session only after individual planning had been completed. For a detailed minute-by-minute list of the TDG and TDS scenarios, see Appendix J - TDG/TDS Schedule (Experiment 2).

(1) Leadership. For the leadership evaluations, each participant graded his entire team as a percentage of 100 (the total 100 points was divided among all team members). This grading method was present for only the leadership scores. The other dependent variables (decision-making and situational awareness) were graded on a Likert scale 1-7. The leadership data for the TDG and TDS participants revealed that the designated leader emerged as the perceived leader among all other participants without exception.

Figure 9 summarizes the results from the leadership evaluation between the TDG and TDS groups.

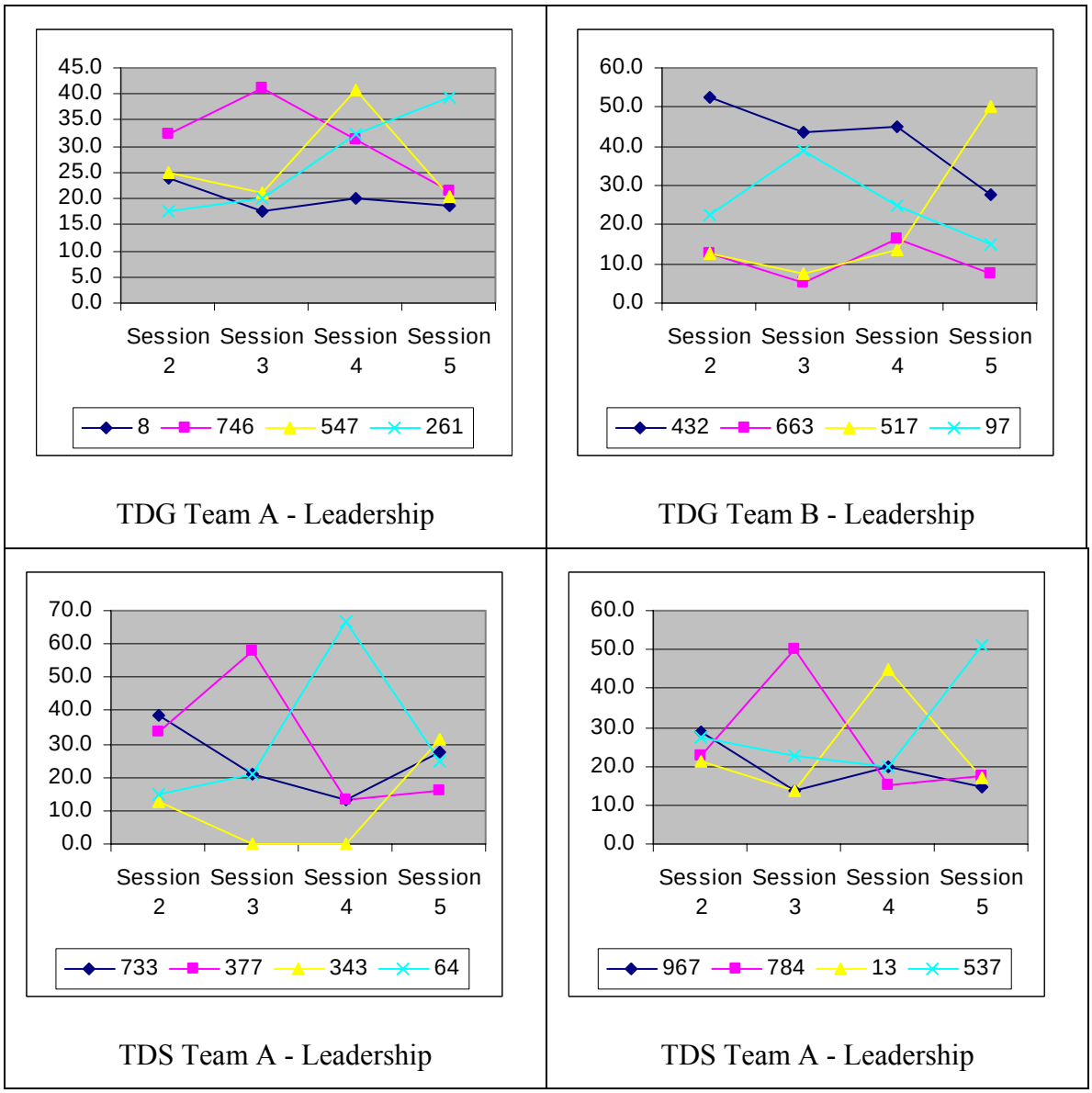


Figure 9. Longitudinal Results - Leadership (Self-Reported)

Figure 9 shows that each TDS participant's leadership scores fluctuated greatly between the sessions in which he/she acted as platoon leader versus those as a squad leader. The TDS scores had a much higher deviation from the mean than the TDG group. This could be attributed to the more active role played by the leader in the TDS group. The TDS platoon leader was generally standing behind his squad leaders directing their action only when they were actively playing CCM. No such

activity was present in the TDG due to the nature of the TDG. In the TDS, though, the leaders were required to act, give orders, make changes to their plan, and suffered consequences of inaction which resulted in troop losses and attacks by a thinking enemy. These activities appeared to propel the TDS leader to a higher level of performance -- a fact born out by the results of the overall scoring by his subordinate squad leaders.

(2) Decision-Making. The overall decision-making trend for the TDG group was relatively flat as seen in Figure 10. The TDS teams were either overall increasing for Team A or decreasing for Team B. Participant number 343 in the TDS Team A was absent from Sessions 3 and 4 and, therefore, received no score (a score of zero). Interestingly, this trend of teammates grading one another higher in decision-making, when they won the scenario, and lower, when they lost, corresponded to the win/loss results and spanned all sessions for TDS teams. Team A was defeated decisively in Sessions 2, 3, and 4, but made improvements in their ability to work together and in their decision-making ability. Team B's performance decreased over the course of all sessions. Even though they won all but the last session, Team A continued to improve at a faster rate than Team B. They were defeated in the last session due to the superior firepower (availability of artillery) used by their opponent. These trends could indicate that the team members were equating their ability to make decisions with the outcome of the sessions.

Even though all teams were randomly assigned, three of the four members of TDS Team B had been classmates in previous NPS courses and are now all in the same Human Systems Integration curriculum. The graph of TDS Team B could indicate an initial overconfidence in their ability to work together. However, this decreased over time as the other team became more successful. The graph of TDS Team A - Decision-Making could indicate that the group was coalescing as a team throughout all sessions. They worked better together and were able to make better decisions as the sessions progressed.

Figures 10 and 11 demonstrate a consistency between the sessions on decision-making and situational awareness. As stated earlier, participant 343 of TDS

Team A received a score of zero in Sessions 3 and 4. This was a result of 343's absence from the experiment during those two sessions.

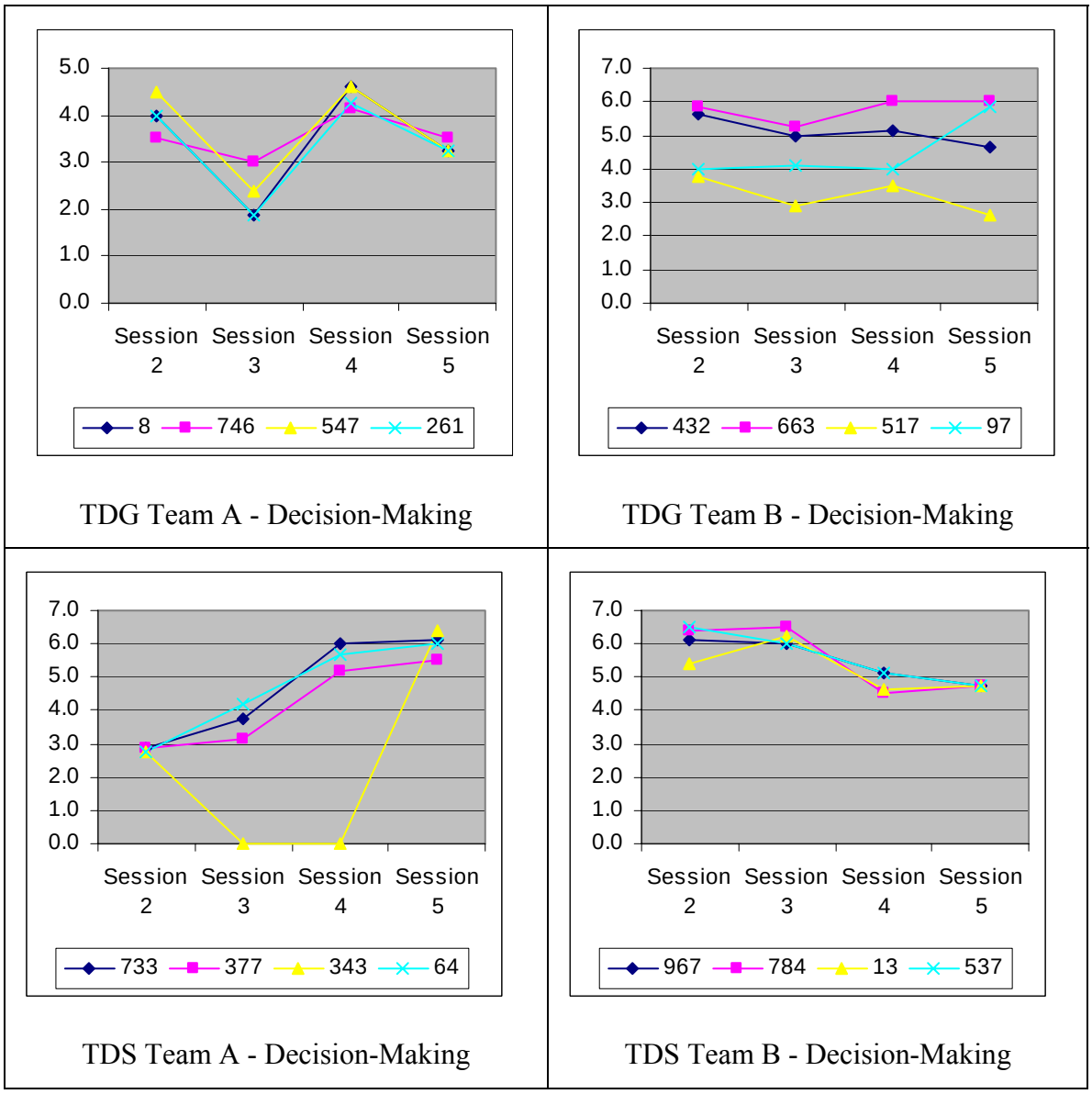


Figure 10. Longitudinal Results - Decision-Making (Self-Reported)

(3) Situational Awareness. The graphs in Figures 10 and 11 are almost identical for both TDG and TDS groups. The participants' scores indicate that the TDG and TDS groups' situational awareness scores over all sessions correspond strongly to their decision-making scores.

Figure 11 provides a basis for comparing SA between the two groups (TDG & TDS).

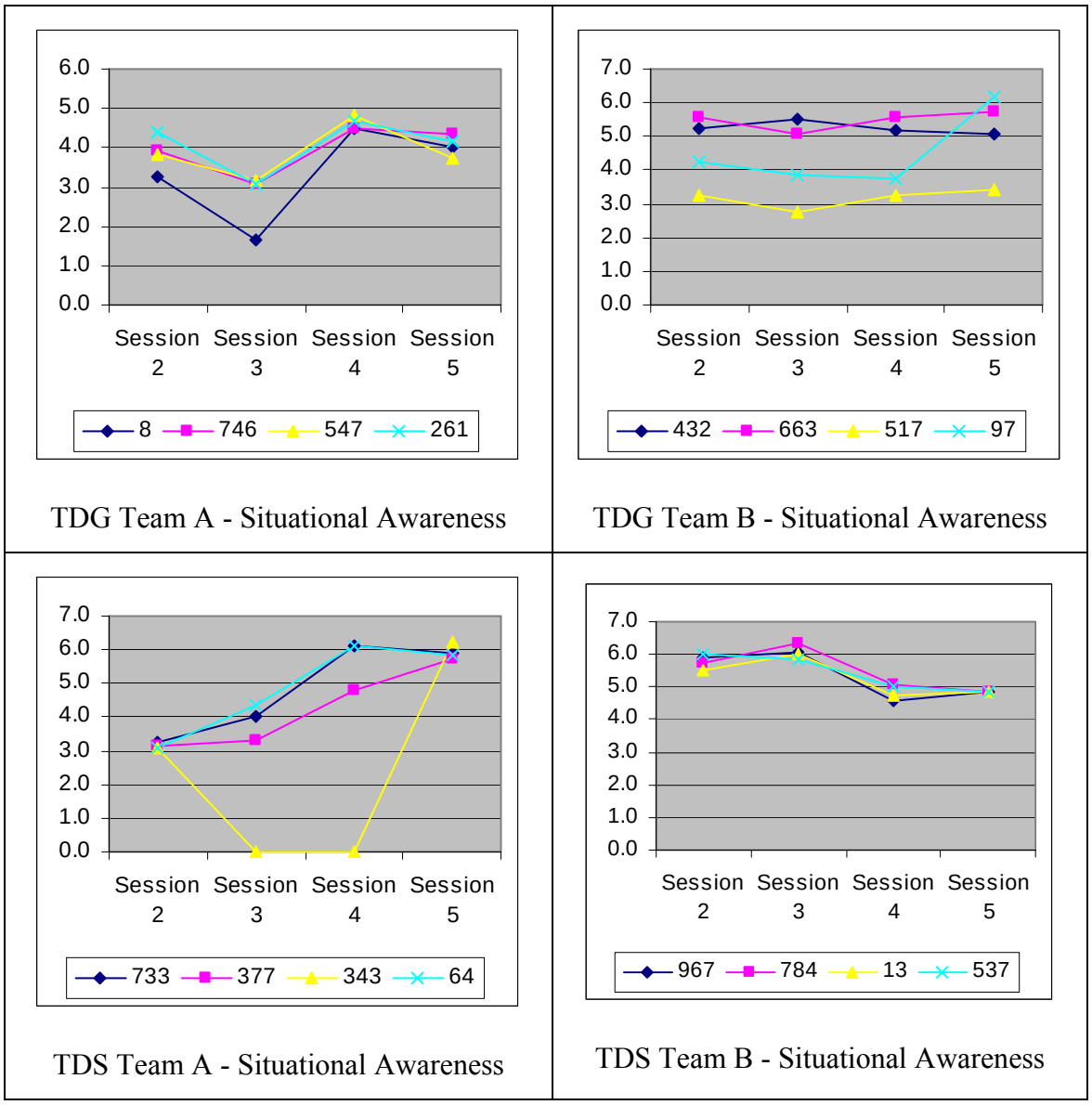


Figure 11. Longitudinal Results - Situational Awareness (Self-Reported)

The previous longitudinal graphs show the overall results for leadership, decision-making, and situational awareness for all participants in the TDG and TDS groups across all sessions.

During this study, we were concerned with several more parameters beside the leadership, decision-making, and situational awareness skills. We were, also, interested in how other key skills required of a platoon level leader could be improved through the use of the TDG and TDS. Figures 12 and 13 show the absolute and relative improvement within the two training groups (TDG and TDS) from the beginning session to the final session. We drew this information from questions 4 and 5 in the final TDG questionnaire and questions 14 and 15 in the final TDS questionnaire. The scores reflected in Figures 12 and 13 are averages for all participants in the TDG and in the TDS groups. They, also, show that there was a perceived improvement across all domains. Figures 12 and 13 demonstrate the difference between the absolute scores at the beginning of Session 1 and the absolute and relative improvement reported in the final questionnaire after the final session.

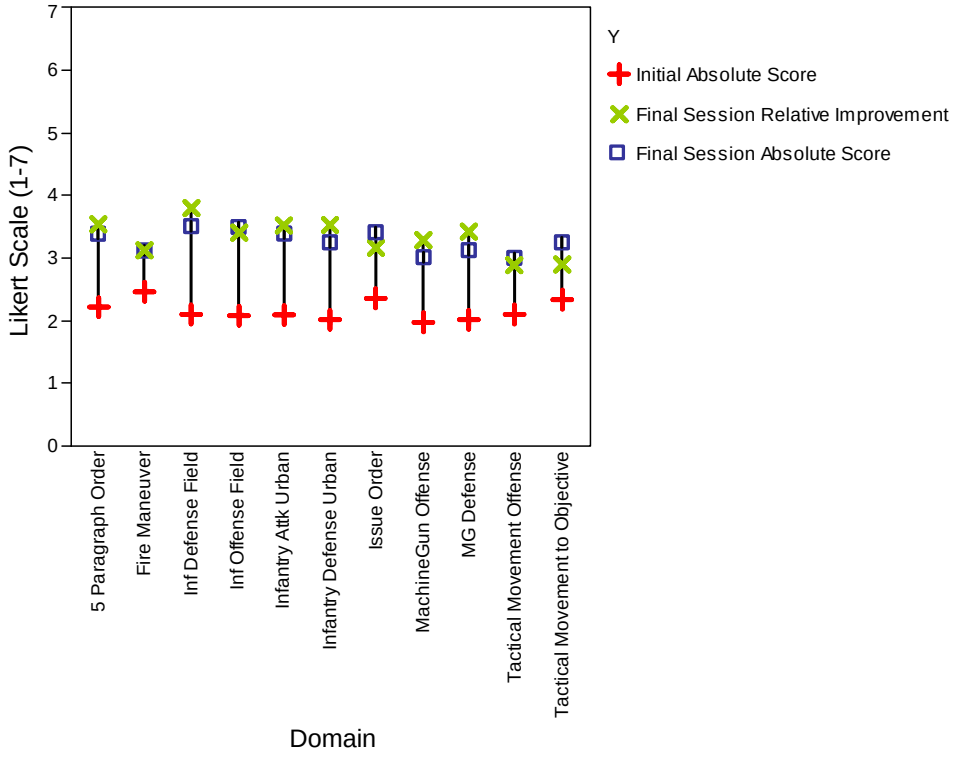


Figure 12. TDG Absolute and Relative Improvement

In Figure 12, we can see that participants stated that they showed improvement over all domains because each line has some measurable length. Since the TDG is a pen and paper drill with no simulation involved, participants only had the ability to engage in the scenario within their own mind. They never saw it played out in an objective manner. We believe that this was the reason why the "Tactical Movement to an Objective" and the "Fire & Maneuver" tasks showed the least amount of improvement. However, overall perception of absolute and relative improvement across all domains was small. Although TDG and TDS subjects participated equally in offensive and defensive scenarios, the TDG group believed that they improved more on the defensive tasks. In Figure 13, we can see that the magnitude of the improvements in the TDS group was greater than in the TDG group. However, this was not by a significant margin.

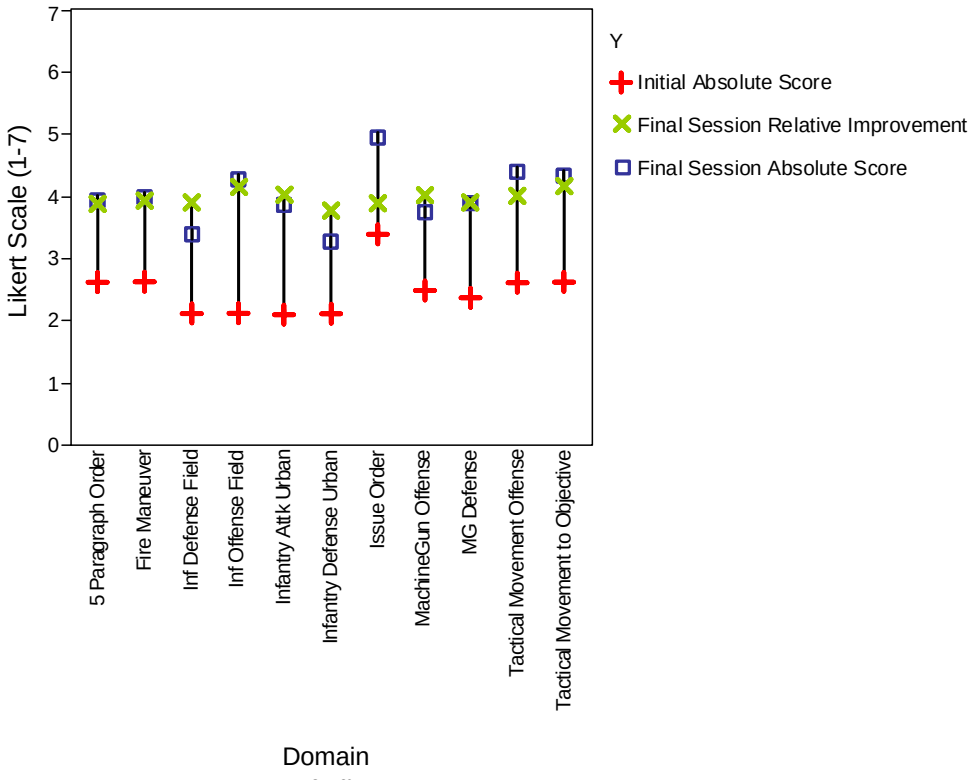


Figure 13. TDS Absolute and Relative Improvement

In Figure 13, TDS participants stated that they felt they improved over all domains, though some more than others. We noticed that in the "Issue Order" domain, their relative improvement was far less than their absolute score. The domains "Tactical Movement in the Offense" and "Tactical Movement Objective", also, demonstrated this same condition, but was by an insignificant amount. We believe that the minimal improvement on the "Issue an Operation Order" task was because participants did not issue operation orders; rather, the orders were only provided for them in written form. The TDS participants, also, practiced offensive and defensive tactics equally. However, they thought that they improved most in offensive operations. This is in direct opposition to the TDG group results. We believe that the TDG format implied, to the students, that they were in more of a defensive role, while the TDS format implied more of an offensive role.

b. Hypothesis Testing - TDG/TDS Participant Scores

Since our experiment was about testing and evaluating leadership, decision-making, and situational awareness, we decided to examine them based on differences between the TDG and the TDS groups. A t-test was used because there were only two different experimental groups. Since there was no good reason to believe that the scores would fall in a particular direction, we decided to use a 2-tailed t-test to evaluate the variables. For all hypothesis tests, we chose the α level = 0.05 to be significance level controlling whether to reject the null hypothesis or not.

(1) Peer Evaluation.

Leadership. The participants' peer leadership scores were taken from question 2 on questionnaires from Sessions 2-5. Each participant received a leadership score from his teammates such that there were a total of three different scores per participant. This was averaged to achieve a session average and was repeated for all sessions. Finally, all participant session averages were averaged again to find the total leadership score for each participant.

Ho (Null Hypothesis) = There is no difference between the TDG and TDS participant leadership scores given by their peers.

Ha (Research Hypothesis) = There is a difference between the TDG and TDS participant leadership scores given by their peers.

A 2-tailed t-test determined $p = 0.8747 > 0.05$. We do not reject the null hypothesis. We conclude that there is no difference between the participants' scores when evaluated by their peers on leadership when comparing the TDG and TDS groups. This suggests that the TDG and the TDS provide opportunity to exercise and to evaluate leadership.

Decision-Making. The participants' peer decision-making scores were taken from questions 8, 9, and 12 on questionnaires from sessions 2-5. Each participant received a decision-making score from his teammates such that there were a total of three different scores per participant. This was averaged to achieve a session average and was repeated for all sessions. Finally, all participant session averages were averaged again to find the total decision-making score for each participant.

Ho (Null Hypothesis) = There is no difference between the TDG and TDS participant decision-making scores given by their peers.

Ha (Research Hypothesis) = There is a difference between the TDG and TDS participant decision-making scores given by their peers.

A 2-tailed t-test determined $p = 0.0356 < 0.05$. We do not reject the null hypothesis. We conclude that there is a difference between the TDG/TDS participants' scores on the peer decision-making evaluation. Since we assigned the participants into groups randomly, we think that the real difference was caused by the method used, not by differences in how the peers scored each other within the groups.

Situational Awareness. The participants' peer Situational Awareness scores were taken from questions 12 and 16-18 on questionnaires from Sessions 2-5. Each participant received a situational awareness score from his teammates such that there were a total of three different scores per participant. These were averaged to achieve a session average and were repeated for all sessions. Finally, all participant session averages were averaged again to find the total decision-making score for each participant.

Ho (Null Hypothesis) = There is no difference between the TDG and TDS participant Situational Awareness scores given by their peers.

Ha (Research Hypothesis) = There is a difference between the TDG and TDS participant Situational Awareness scores given by their peers.

A 2-tailed t-test determined $p = 0.0068 < 0.05$. We reject the null hypothesis and conclude that there is a difference between the participants' scores on the peer situational awareness evaluation in TDG and TDS. Since we assigned the participants into groups randomly, we think that the real difference is caused by the method used and not by differences in how the peers in the groups scored one another.

(2) Researcher Evaluation.

Leadership. We, also, evaluated the TDG and TDS participants with respect to their leadership. Their scores were taken from the Researcher Evaluation Form (see Appendix N) questions 15-16. Each participant was chosen to be the team leader for exactly one session. This was the only session for which we evaluated him and obtained a leadership score.

Ho = (Null Hypothesis) There is no difference between TDG and TDS participant leadership scores given by the researchers.

Ha = (Research Hypothesis) There is a difference between TDG and TDS participant leadership scores given by the researchers.

A 2-tailed t-test determined $p = 0.1765 > 0.05$. We do not reject the null hypothesis. We conclude that there is no difference between the participants' scores on researcher leadership evaluation in TDG and TDS.

Decision-Making. We also evaluated the TDG and TDS participants with respect to their decision-making ability. Their scores were taken from the Researcher Evaluation Form (see Appendix N) questions 13-14. Each participant was chosen to be the team leader for exactly one session. This is the only session for which we evaluated him and obtained a leadership score.

Ho = (Null Hypothesis) There is no difference between the TDG and TDS participant decision-making scores given by the researchers.

Ha = (Research Hypothesis) There is a difference between the TDG and TDS participant decision-making scores given by the researchers.

A 2-tailed t-test determined $p = 0.1606 > 0.05$. We do not reject the null hypothesis. We conclude that there is no difference between the participants' scores on the researcher decision-making evaluation in TDG and TDS.

Situational Awareness. We were able to evaluate the TDS participants on their SA, but not for the TDG participants. The TDS group had a CCM, which maintained a state of all enemy and friendly unit locations. As we mentioned earlier, we drew their ground truth from this system with an SA instrument called the Geographical Recall and Analysis of Data in the Environment (GRADE) (Miller & Shattuck, 2007). We compared each participant's GRADE sheet with ground truth on a Likert scale 1-7. Their average SA score was a 4.19. The TDG group had no ground truth from which to draw because they did not use a computer system that maintained a record of their planning process. As a result, their SA could only be evaluated based on a subjective peer assessment from the questionnaires.

(3) Summary of Results. Results of the Hypothesis tests for leadership, DM, and SA are located in the tables below. Table 9 presents the summary of the peer evaluations and Table 10 presents the instructors' evaluations.

Table 9. Peer Evaluation t-test Comparing TDG/TDS

	P Value	Result
Leadership	$p = 0.8747 > 0.05$	No significant difference between TDG/TDS leadership scores
Decision Making	$p = 0.0356 < 0.05$	Significant difference between TDG/TDS decision-making scores
Situational Awareness	$p = 0.0068 < 0.05$	Significant difference between TDG/TDS SA scores

Table 10. Instructor Evaluation t-test Comparing TDG/TDS

	P Value	Result
Leadership	*p = 0.1765 > 0.05*	No significant difference between TDG/TDS leadership scores
Decision Making	*p = 0.1606 > 0.05*	No significant difference between TDG/TDS leadership scores
Situational Awareness		* No Basis for Comparison *

The TDG was a mental simulation that was not based upon a collective understanding of ground truth for the scenario. Each person had his own understanding of where the enemy was and what they were doing. The TDS group had ground truth established from within the computer simulation. Due to the varying nature of these two methods for determining situational awareness, there was no basis from which to compare the TDG and the TDS from the instructor's point of view.

c. TDG Correlation Analysis

All factors were scored based on each participant's subjective perception of the questions asked. In other words, if the participant was grading his peers on leadership, he scored them based on his own opinions and understanding of what a good or bad leader should be. This was true for all factors in the below analysis.

(1) Factor: Talkativeness Predicts Leadership.

Questions

- Leadership Question (Sessions 2-5/Question 2) - Each participant was asked to provide a score between 0 and 100 for each of their team members. The final score must total 100. This score essentially ranked the participants with regard to their perceived leadership ability during the sessions.
- Talkativeness Question (Sessions 2-5/Question 6) - The same scoring method (between 0 and 100) was used for the amount of talkativeness exhibited by the participants during the sessions.

Results

Figure 14 demonstrates that there is a strong linear relationship between talkativeness and the perception of leadership.

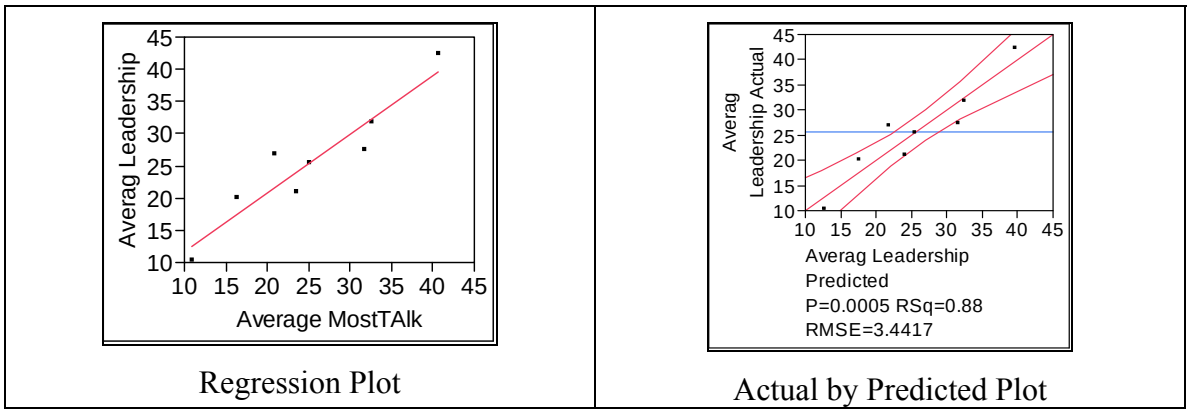


Figure 14. Graph - Talkativeness/Leadership

The P value for the test for significance of regression is P = 0.0005 and RSqr = 0.88. This clearly indicates strong evidence that talkativeness is linearly related to leadership.

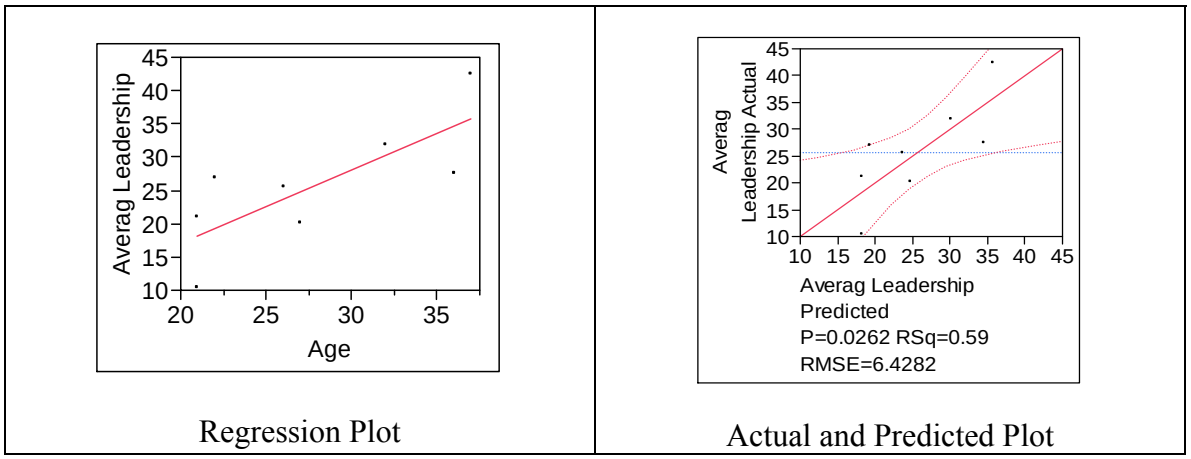
(2) Factor: Age Predicts Leadership.

Questions

- Age Question. (Session 1/Question 9) - This question asked for the participant's year of birth. The age was determined by subtracting this from the current year.
- Leadership Question. (Sessions 2-5/Question 2) - see Factor: Talkativeness Predicts Leadership.

Results

Figure 15 demonstrates a strong correlation between age and the perception of leadership.



Regression Plot | Actual and Predicted Plot

Figure 15. Graph - Age/Leadership

The P value for the test for significance of regression is P = 0.0262 and RSqr = 0.59. The regression Model indicates that Age is a strong predictor of perceived leadership ability. In other words, the older the participant was the stronger leadership score he received.

(3) Factor: Situational Awareness Predicts Good Decision-Making.

Questions

- Decision-Making Question (Sessions 2-5/Question 12: Items 8 & 9) - Participants were asked about their opinion of their teammates with regard to their ability to identify the enemy's center of gravity and to attack it. Also, they were asked about how well the other team members adjusted to the changing enemy situation. All scores were graded on a 1-7 Likert Scale.
- Situational Awareness Question. (Sessions 2-5/Question 12, Items 16, 17, & 18) - Participants were asked about their confidence regarding the enemy location, enemy size, and direction of enemy movement.

Results

Figure 16, also, demonstrates that SA is strongly correlated with the ability to make decision-making.

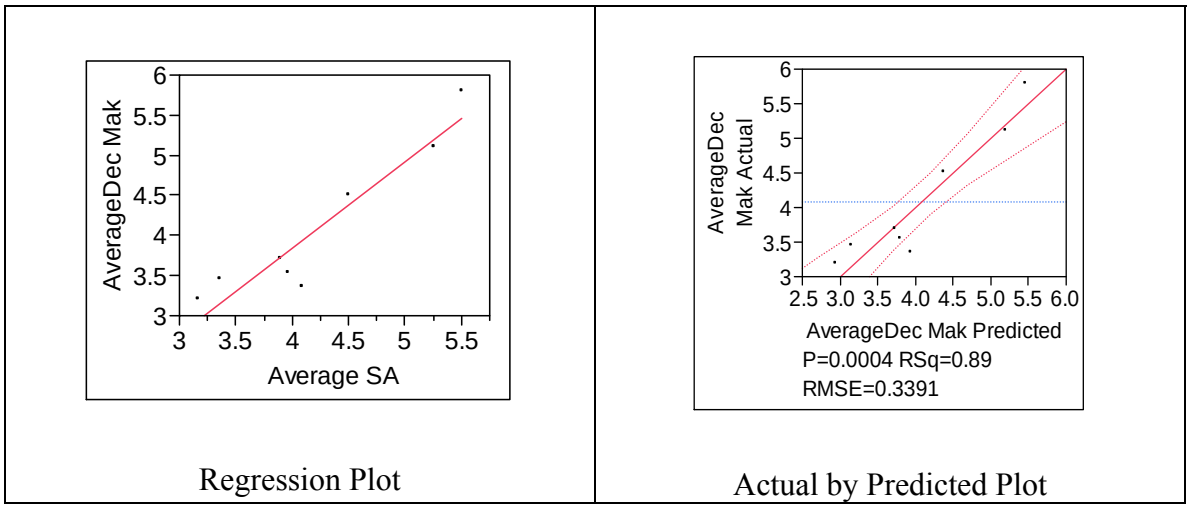


Figure 16. Graph - Situational Awareness/Decision Making

The P value for the test for significance of regression is P = 0.0004 and RSqr = 0.89. This clearly indicates strong evidence that decision-making is linearly related to situational awareness.

(4) Factor: Correlation between the Internal Team Members' Scores and the Instructors' Score on Leadership.

Questions

See above Talkativeness Predicts Leadership. This measure examined the relationship between the leadership score a participant received from his fellow teammates and the leadership score the instructors gave him during his role as team leader.

Results

Figure 17 shows that there is some relationship between the instructor leadership score and the leadership score that the participants received from their peers.

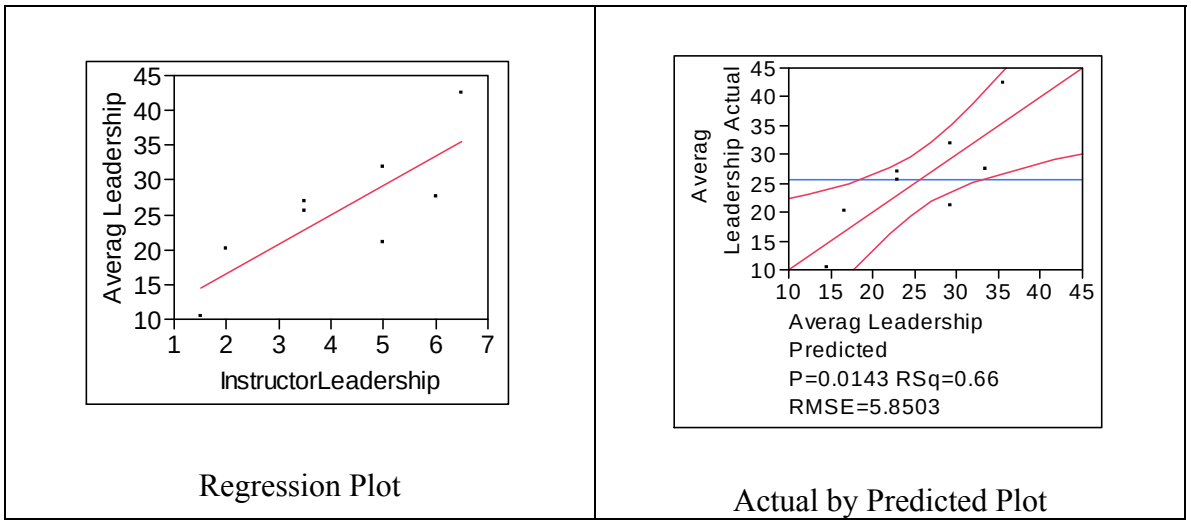


Figure 17. Graph - Instructor Leadership/Perceived Leadership

The P value for the test for significance of regression is P = 0.0143 and RSqr = 0.66. This clearly indicates that there is evidence that the instructor evaluation of the participants' leadership ability is linearly related to the leadership evaluation given to the participant by his peers.

d. TDS Correlation Analysis

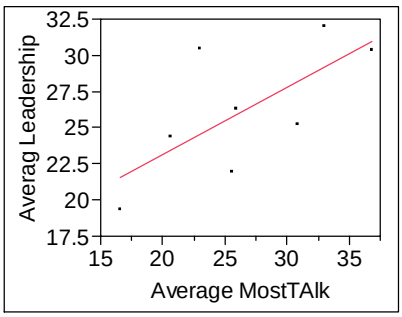
(1) Factor: Talkativeness Predicts Leadership.

Questions

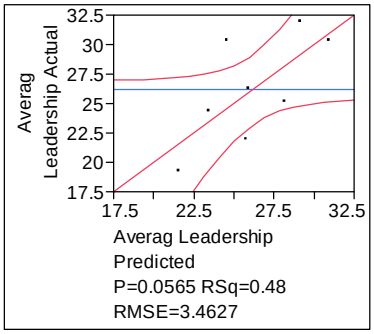
- Leadership Question (Sessions 2-5/Question 2) - Each participant was asked to provide a score between 0 and 100 for each of their team members. The final score must total 100. This score essentially ranked the participants with regard to their perceived leadership ability during the sessions.
- Talkativeness Question (Sessions 2-5/Question 6) - The same scoring method (between 0 and 100) was used for the amount of talkativeness exhibited by the participants during the sessions.

Results

Figure 18 demonstrates a weak correlation between talkativeness and leadership.



Regression Plot



Actual by Predicted Plot

Figure 18. Graph - Talkativeness/Leadership

The P value for the test for significance of regression is P = 0.005 and RSqr = 0.48. This indicates evidence that talkativeness is linearly related to leadership.

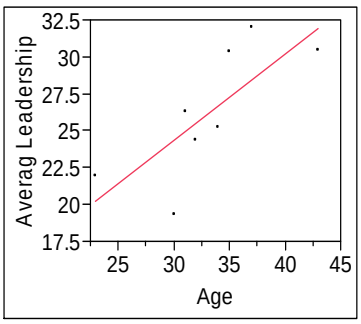
(2) Factor: Age Predicts Leadership.

Questions

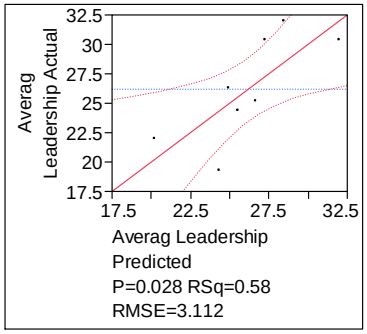
- Age Question. (Session 1/Question 9) - This question simply asked for the participant's year of birth. The age was determined by subtracting this from the current year.
- Leadership Question. (Sessions 2-5/Question 2) - see Factor: Talkativeness Predicts Leadership.

Results

The regression plot below in Figure 19 demonstrates that age is correlated with the perceived leadership scores.



Regression Plot



Actual By Predicted Plot

Figure 19. Graph - Age/Leadership

The P value for the test for significance of regression is P = 0.028 and RSqr = 0.58. This indicates evidence that age is linearly related to leadership.

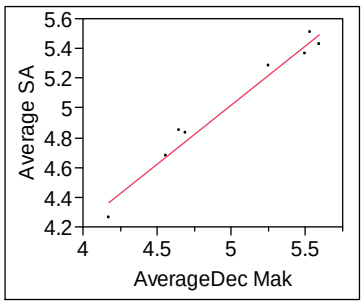
(3) Factor: Situational Awareness Predicts Good Decision-Making.

Questions

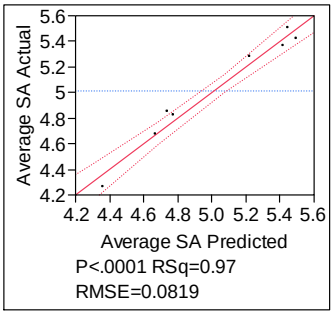
- Decision-Making Question (Sessions 2-5/Question 12: Items 8 & 9) - Participants were asked about their opinion of their teammates with regard to their ability to identify the enemy's center of gravity and to attack it. Also, they were asked about how well the other team members adjusted to the changing enemy situation. All scores were graded on a 1-7 Likert Scale.
- Situational Awareness Question. (Sessions 2-5/Question 12, Items 16, 17, & 18) - Participants were asked about their confidence regarding the enemy location, enemy size, and direction of enemy movement.

Results

Figure 20 clearly demonstrates the strong correlation between decision-making and situational awareness.



Regression Plot



Actual by Predicted

Figure 20. Graph - Decision-Making/Situational Awareness

The P value for the test for significance of regression is $P < 0.0001$ and RSqr = 0.97. This clearly indicates strong evidence that decision-making is linearly related to situational awareness.

(4) Correlation between Time in Service (TIS) and Leadership.

Questions

- Time in Service Question: Session 1/Question 15 - This question asked for the participant to state the number of years and months he has been in military service.
- Leadership Question: (Sessions 2-5/Question 2).

Results

Figure 21 shows a strong correlation between TIS and leadership.

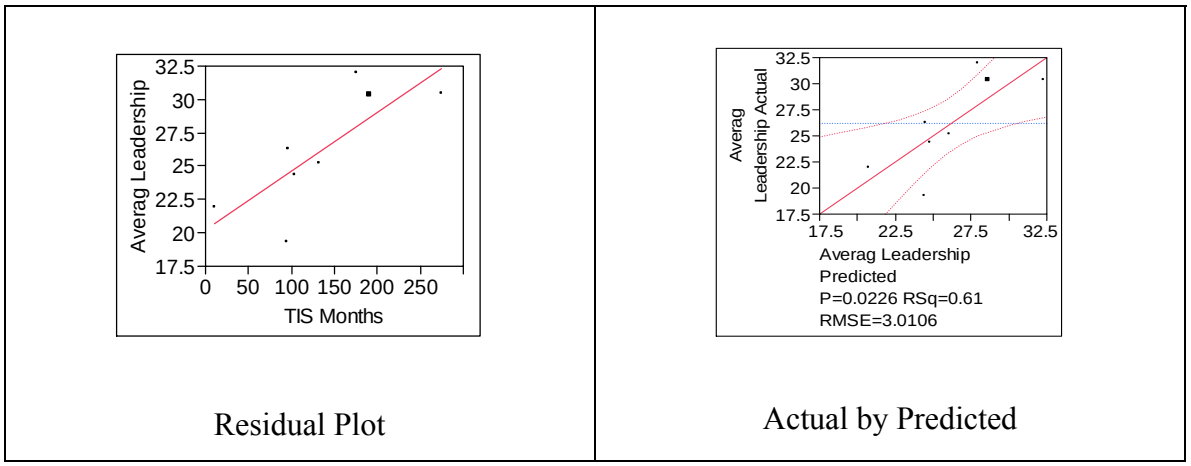


Figure 21. Graph - Time in Service/Leadership

The P value for the test for significance of regression is P = 0.0226 and RSqr = 0.61. This indicates evidence that TIS (months) is linearly related to leadership.

e. TDG/TDS Summary of Results

Table 11 summarizes the correlation results from Experiment 2. P Values below 0.05 indicate significance.

Table 11. Summary Comparison of TDG/TDS Results for Significance

	TDG		TDS	
	P value	R-Squared	P value	R-Squared
Leadership (Peer Evaluated) VS Talkativeness (Peer Evaluated)	0.0005	0.88	0.005	0.48
	Strong Correlation		Correlation	
Leadership (Peer Evaluated) VS Age	0.0262	0.59	0.018	0.058
	Correlation		Correlation	
Leadership (Instructor Evaluated) VS Leadership (Peer Evaluated)	0.0143	0.66	0.617	0.04
	Correlation		No Correlation	
Situational Awareness (Peer Evaluated) VS Decision Making (Peer Evaluated)	0.0004	0.89	< 0.001	0.97
	Strong Correlation		Strong Correlation	
Time in Service VS Leadership (Peer Evaluated)	0.09	0.4	0.0226	0.61
	Weak Correlation		Correlation	

f. Qualitative Analysis

The experiment produced a number of qualitative results that were interesting and should be included. These include data, such as verbal participant comments regarding their group's experience, researcher observations, as well as, the participant's answers to open-ended questions from the questionnaires. In some cases, these results were more telling than the quantitative ones.

(1) Training Session Duration and Timing. The duration and the number of individual training sessions that are required to achieve a particular skill level have been largely unexplored. We conducted our experiment in five total sessions lasting one hour each. To begin the sessions, we read the operation order and turned the teams over to 3-5 minutes of planning time. After their planning time ended, they had another 3-5 minutes to get their troops into their starting positions before the actual scenarios started. Each actual simulation scenario lasted approximately 40 minutes. We knew that the 3-5 minutes of planning time was not sufficient to create a good tactical plan, but we were constrained by the scenarios lasting 40 minutes. The planning that the teams conducted was quite surprising. We observed that the TDS groups actually had planning time left over and were waiting to start the actual scenario. They appeared to be truncating their plan and rushing into the execution phase. This could be attributed to their heightened level of excitement when preparing to interact with the simulation. This was not only true at the outset of the CCM scenarios, but during the middle of the sessions, too. If a group had a plan to counter some enemy action, they seldom, if ever, executed it. There seemed to be an urge to forget about what they had planned and only use CCM on a moment-by-moment basis.

(2) Overall Session Time was Too Short. The pauses in the sessions that were required to collect SA information ended up pushing the end of the simulation longer than expected. This left virtually no time for participants to fill out their questionnaires. At least 10 minutes should be allowed for participants to properly fill out the questionnaires without feeling rushed. In some cases, the TDG group was able to complete their task in the allotted 1-hour time slot, but even they were rushed during some sessions. The time for each session should be extended to at least 1.5 hours

and preferably two hours. The latter would allow the participants to have sufficient time to plan, complete the entire TDG/TDS scenario, and fill out their questionnaires before departing the area.

(3) Combining the Best of the TDG and the TDS. Military schools that plan to use this type of training should encourage the time tested and superior planning process from the TDG to take place at the beginning of the training sessions. Once unit leaders have established their plans, they should implement them in the TDS to see how each plan holds up under enemy contact. This, also, applies to how the unit leaders and subordinate leaders interact and respond in the tactical virtual environment. The TDS will provide feedback, and an ultimate outcome, which can be discussed in an after action review in terms of the original plan. Subject matter experts should be present throughout to prepare for a robust after action review session.

(4) Team Cohesiveness. We noticed improvement in team cohesiveness over the three days and five separate sessions. During the first session, the TDS sub-groups were somewhat hesitant to communicate with one another before and during the battle. Each participant seemed to be focused on his particular task and paid little attention to his teammates. After the final session, there was a good deal of team cohesion among all groups. Particularly in the final TDS session, TDS Group 1 was victorious and burst out of their seats to slap hands and congratulate each other.

(5) Confusion and Loss of Situational Awareness. Some TDS participants had trouble keeping track of which units were friendly and which were enemy. In their view, they did not know which squads or units were on their side. At times, their confusion led them to fire on their own adjacent units. This was obviously not an issue in the TDG group. This could be used as an important teaching point regarding the confusion of combat and how this could contribute to friendly fire incidents. Instructors could emphasize how important it is to maintain SA at all times.

(6) Pleasant Training Experiences Contribute to Learning. Not all military training can be fun. To emphasize that there are times when the mission has priority even at the expense of one's comfort, some military training must be unpleasant.

However, some training industry experts believe that a pleasurable training experience can contribute to participant learning. According to Michael Allen of Allen Interactions, a Minneapolis training firm, “People remember things through humor.” “When you talk about a lasting learning experience, you recall what is notable about the event. If something unusual or funny happens, you'll probably remember it” (Fister, 1999).

During the final after action review and once all sessions had concluded, the TDS participants reported they were motivated and enjoyed the experience. Conversely, the TDG group reported they became bored with it. This boredom was a fact supported by some of the note pages we collected from the TDG group after their sessions. Some had extensive doodle marks on them indicating that this particular person was able to “wander off” mentally from the planning task in which he was involved. In part of our final questionnaire, we asked participants in both TDG and TDS groups about the quality of their individual training experiences. The scores in Table 12 were taken from the final questionnaires and illustrate interesting differences between the two approaches.

Table 12. Comparison of Quality of Training

TDG		TDS	
Question	Average Score (1-7 Likert)	Question	Average Score (1-7 Likert)
"When you think about your future training needs, to what extent would you like it to be supplemented with TDGs?”	2.75	“When you think about your future training needs, to what extent would you like it to be supplemented with computer based simulations like CCM?”	4.625
“When you think about your future training needs, to what extent would you like it to be supplemented with computer based simulation of a TDG?”	5	* Question Not Applicable *	
"How well did the TDG sessions meet your expectations regarding training value?"	3.1	"How well did the TDS sessions meet your expectations regarding training value?"	4.5
"The TDG experience was able to provide me with a good mental picture of the battle space."	3.3	"Rate the simulation's ability to provide you with VISUAL cues so that you can identify all threats within the mission."	4.9
		"Rate the simulation ability to provide you with AUDIO cues so that you can identify all threats within the mission."	4.6
"In your opinion, what was the overall quality of training in the TDG?"	3.2	"In your opinion, what was the overall quality of training in the TDS?"	4.9

Table 12 indicated a desire by all participants to incorporate computer based simulation into their training. What makes this so significant is that the TDG group indicated displeasure with their task and opted for an alternative to it in computer-based simulation. The TDS participants enjoyed their training enough to continue to recommend it be included in future tactical decision-making training regimens. The scores in Table 12, also, indicate that the perception of the quality of training was lower in the TDG group than in the TDS group.

(7) Verbal and Non-Verbal Communications. Some of the participants' communications (verbal and non-verbal), and interactions during the sessions, warrant comment. Our intent was to simulate the communications between platoon leaders and squad leaders in the most realistic way possible. In a field environment, a platoon leader usually traveled with one of his squads. This prevented him from seeing exactly what the other two squad leaders were observing at any particular point in time. We simulated this by advising participants before the sessions began that each squad leader should remain at his own computer and only look at his own screen. Likewise, the platoon leaders should remain with a single squad throughout and not hop back and forth between screens. Verbal communication would be heard by all as if they were all on the same radio network. This did not occur. During the sessions, we constantly reminded the squad leaders to remain in their seats and to keep their focus on their screens (their view of the battle space). However, they got up to help their fellow squad leaders who were having trouble or who were unable to understand what was going on in their view of the simulation. In like manner, the platoon leaders were consistently looking over at their other squad leader's computer screens in, what we believe, was an attempt to garner more SA before they made decisions.

5. Summary

The following five points were significant findings from the summary of quantitative and qualitative results in Experiment 2.

- In the longitudinal analysis across all sessions, we observed that participants received their highest leadership scores when they were designated as the leader in the TDG and the TDS sessions. However, the

TDS participants had a much higher deviation from the mean on leadership because they were acting in the role of a leader by standing, issuing orders, and supervising their squad leaders during the virtual battle.

- TDS participants seemed to equate a favorable outcome in the simulation with good decision-making. This may or may not be true, but their scores consistently supported this concept. We found that peer evaluations were strongly correlated between the participants' decision-making and situational awareness scores.
- We tested the hypothesis that there was a difference between the TDG and TDS leadership, decision-making, and SA scores. We believed that the methods were the cause of differences with respect to decision-making and situational awareness when evaluated by peers. When we evaluated the groups, there was no significant difference between the methods when examining decision-making and leadership. We were not able to evaluate if there was a significant difference between the groups on situational awareness because we were unable to obtain SA data from the TDG group.
- Internal to the TDG and TDS groups, we found that perceived leadership was correlated with talkativeness, time-in-service, and age. SA and decision-making were strongly correlated in both groups.
- Our qualitative assessment determined that an improved approach to training with tactical decision-making simulations should be considered. We believe that a new approach, which we call the Integrated Tactics and Planning Simulation Exercise (ITAPSE), would bridge the best of both training approaches (TDS & TDG). The TDS was conducted almost exclusively within the virtual environment and seemed to be more engaging to the participants. The TDS experience was exciting and allowed each participant to play a highly active role. The TDG was conducted with pen and paper. It prompted more thought about individual actions and fostered more thorough planning. The ITAPSE combines the planning techniques of the TDG with the ability to implement and execute that plan via the TDS.

IV. RECOMMENDATIONS AND FOLLOW-UP EXPERIMENT

A. RECOMMENDATIONS

After the experiment and data analysis were completed, there were several recommendations that we identified. These fall into the following categories:

1. Improvements to the CCM Software for TDS Use

We believe that if CCM is to continue to be used as a TDS for training, the following modifications to the code and meta-data would provide for a richer experience for the students:

a. Operation Orders

Administrators should ensure that the operation orders are corrected so that the information is accurate and consistent for both groups. The orders used in this experiment contained numerous acronyms and jargon that was specific to an infantry environment. This would be acceptable for military personnel who have been trained in infantry TTPs, but not for members of other services and especially not for Foreign Service members.

Some information that would be critical to the TDG group was excluded entirely from the orders. The orders were adapted for use by the TDG group, but were originally written by the CCM developers for the TDS group. Information, such as the current location of one's own unit, was not included. The TDS group would immediately understand where their unit was located when they started CCM, but the TDG group had no ability to get this information. We had to estimate the TDG groups' locations during the TDG sessions to give them a starting point.

Orders, also, had conflicting and erroneous information. The operation orders that we used are located in Appendix K. Session 1-1a's Operation Order stated that the company had been provided no mortar support, yet the Task Section of the order stated plainly that mortar priority of fire was to third platoon.

b. Pause Feature

When the current system was paused, it was difficult to establish ground truth of unit locations because each participant's screen was on a different part of the battlefield. Internal simulation algorithms, that display only what the participant's team avatars within the simulation are capable of seeing based on distances and terrain features, controlled the number of troops visible to the individual.

c. Integrated Situational Awareness Measurement Tool (ISAM-T)

Future editions of CCM should incorporate a built-in SA evaluation tool that will present an SA screen to the user at preset or instructor controlled points during the sessions. The GRADE SA evaluation tool used in this experiment was difficult to administer because the TDS did not have a good mechanism to pause the simulation. On two separate occasions, users accidentally quit the TDS and forced a complete restart of the scenario. This wasted approximately 20 minutes of session time.

Additionally, ISAMT could internally calculate distances, size, and locations of friendly/enemy units and compare this to ground truth. This will return an objective difference score between where the student thought the enemy/friendly forces were and where they actually were. Based on this criteria, the simulation will grade the student and provide an objective measure of SA. This information could, also, be saved and used by instructors/SMEs in the AAR portion of the scenario.

d. XML Output File

"Many simulations provide none or only rudimentary support for AAR" (Sadagic, 2007). CCM does provide some after action information output to the screen at the end of the simulation, but here is no file on which a researcher could run statistics to look for possible trends. We suggest incorporating an XML output file that would provide results for each player in CCM. This could be used to extract objective data for each player in the team. It could provide a way to evaluate their tactical decision-making in terms of distances covered at a run, number of rounds expended per unit time, unit proximity to adjacent units, and whether or not the student fired on friendly troops.

e. Instructor/Administrative Workstation

CCM should include an administrative workstation that would allow for instructor's observation and control of friendly and enemy units. This would allow the instructor to maintain oversight of both sides during the entire scenario. From this station, he would be able to pause the TDS and administer the automated SA evaluation that we suggested as a new feature.

f. True Record/Playback

We recommend incorporating a true record/playback feature for action review purposes into this master workstation. The current playback feature within CCM has some level of interaction available to it (the user can interact with the recorded session as it is playing and alter the outcome). Additionally, in the current CCM record feature, time is constant and non-variable (1 second = 1 second). We recommend that developers include a fast-forward capability so that TDS administrators can move quickly to critical points in the battle to illustrate specific learning.

g. Virtual White Board

We recommend including a virtual white board overlay. Instructors would draw on the master screen to illustrate tactical accomplishments or mistakes. The instructor screen drawing could show up on some or all students' screens.

h. Re-designation of Unit Leadership

If the actual platoon leader is killed in battle, CCM should allow for the designation of another platoon leader. CCM has leadership rings both around each team and team leader to indicate that certain individuals have more leadership capability than others. The proximity of troops to their leader improves their morale. If a team leader dies in battle, his troops will be more likely to panic in the face of enemy fire.

2. Potential Bugs in CCM.

a. Observer Mode

We believe we identified a bug in the software. During one of the sessions, two players' screens went into observer mode. This term "observer mode" describes a condition where visualization on screen was present, but interaction with the system was not possible for the participant. One reason for this resulted when a participant's entire squad was killed by enemy fire and, therefore, had no troops to control. However, the other reason for the case of "observer mode" was undetermined. We looked through the manuals for indications as to why this would have happened, but found none.

b. Potential Memory Leak in CCM

We noticed some anomalies with the networked configuration of CCM during the TDS sessions. Future administrators of the experiment should ensure that computers are freshly booted before starting each session. On one occasion, to reduce the amount of setup time, we left the machines on overnight and at the network setup screen. After this long period of computer inactivity, some of the computers would not synchronize with the host in multiplayer mode. We finally had to reboot all six computers before CCM would synchronize over the network.

B. SUGGESTIONS FOR A FOLLOW-UP EXPERIMENT

If future research efforts try to replicate this study, or to examine certain components in more detail, then researchers might want to consider the following:

1. Participants

Search for a pool of subjects that are closer to the actual population for which TDS training will be implemented. This might be used to confirm the previous findings in this study. The follow-on study should be conducted at a site where a traditional training approach to tactical decision-making is already being used so that the training approaches can be easily compared and measured.

2. Use of Subject Matter Experts (SMEs)

It would be good to have two SMEs per TDS subgroup who will comment on and guide discussions during the simulation. Even more importantly, they can conduct after action review (AAR) sessions and speak from their experiences. The CCM TDS was developed with doctrinally sound infantry TTPs, but feedback from the system in this regard was not presented to the users during our experiment. Infantry SMEs are an essential part of training when using a TDS.

3. Integrated Tactics and Planning Simulation Exercise (ITAPSE)

We strongly suggest combining the best features of both the TDS and the TDG into TAPSE. This approach would incorporate the superior methodical planning techniques of the TDG with the ability to implement one's plan and receive feedback provided by the TDS. Dr. Sadagic (2007) of the Naval Postgraduate School, MOVES Institute states, "...practitioners should be encouraged and offered time to explore a synergy of old (proven) training environments they know very well and simulations." This quote, and our findings in Experiment 2, underscores the need to build a combined approach to tactical decision-making training.

4. Focus on Planning

We recommend that planning be examined in two different ways: between a TDG and TDS group and between a traditional TDS group and one that implemented ITAPSE.

Another suggestion would be to vary the planning time for each group and, also, to look for correlations between which participants quickly gave up their primary plan compared to the time they spent creating their plan. Record the reasons participants provide for their decision to change their plans.

Future researchers might consider evaluating how quickly participants change their plans if they did not seem to be working. Then, record the rationale that led them to believe that their plans were not working.

Finally, they might evaluate whether participants tended to stick with their original plan or if there was a tendency to disregard it at the earliest opportunity. Record

the time it took participants to realize that their original plan was not working and that the situation required a shift to an alternative COA. If they chose to deviate from their plan, did they have a justifiable reason to do so?

5. Examine Personality Factors

TDS participants had trouble keeping track of which units were friendly and which were enemy. Future studies could consider evaluating personality traits to determine whether there is a correlation with a participant's tendency to rush into battle or to dig-in and wait.

6. TDS After Action Review (AAR)

Incorporate an after-action review session into each TDS session. A sufficient amount of time should be included in the sessions in order to accommodate this discussion.

We believe that a thorough examination of the previous items, within the context of a follow-on study, could yield many interesting results such as a correlation between extroversion and perception of leadership performance and/or a successful outcome within the simulation. Additionally, future research might determine that a lengthy planning session correlates to more resistance to changing the plan upon enemy contact. Finally, the ITAPSE method of training decision-making skills could offer students the best that TDG and TDS to offer.

APPENDIX A - CONSENT FORM (EXPERIMENT 1)

Naval Postgraduate School
Participant Consent Form &
Minimal Risk Statement

Introduction. You are invited to participate in a study entitled Evaluation of the Preliminary Training for Virtual Simulations being conducted by the Naval Postgraduate School MOVES Institute.

Procedures. We will use the Human Systems Integration Laboratory (HISL) to conduct an experiment examining three different training methods. We will evaluate training approaches for operating a Tactical Decision-Making Simulation (TDS). The TDS is called Close Combat Marine (CCM) version 4.0 and is a virtual environment (a simulation) used by the USMC to train Marines in tactical decision-making. The researchers will provide the participants with a brief (no more than 5 minutes) explanation of the TDS and what they will be doing during the simulation. We will collect user computer simulation experience and demographics in the form of a questionnaire prior to the commencement of hase I.

Phase I will consist of a learning scenario where participants will learn how to operate the TDS. This phase will last approximately 30 minutes.

In Phase II, the participants will go through a scenario a second time.

In the final phase, Phase III, the researchers will administer a participant survey. Each participant will go through only one of the scenarios for Phase I and one scenario for phase II, a total of 2 scenarios.

The researchers will record participants' actions using a video camera (Note: participants themselves will not appear in the video).

Risks and Benefits. I understand that this project does not involve greater than minimal risk and involves no known reasonably foreseeable risks or hazards greater than those encountered in everyday life. I have, also, been informed of any benefits to myself or to others that may reasonably be expected as a result of this research.

Compensation. I understand that no tangible reward will be given. I understand that a copy of the research results will be available at the conclusion of the experiment.

Confidentiality & Privacy Act. I understand that all records of this study will be kept confidential and that my privacy will be safeguarded. No information will be publicly accessible which could identify me as a participant and I will be identified only as a code number on all research forms. I understand that records of my participation will be maintained by NPS for 5 years, after which they will be destroyed.

Voluntary Nature of the Study. I understand that my participation is strictly voluntary and, if I agree to participate, I am free to withdraw at any time without prejudice.

Points of Contact. I understand that if I have any questions or comments regarding this project upon the completion of my participation, I should contact the Principal Investigator, C. Neil Fitzpatrick, Capt/USMC, (831) 917-6663, cnfitzpa@nps.edu, or Ümit Ayvaz, Capt/Turkish Army, uayvaz@nps.edu. Any medical questions should be addressed to LTC Eric Morgan, MC, USA, (CO, POM Medical Clinic), (831) 242-7550, eric.morgan@nw.amedd.army.mil.

Statement of Consent. I have read and understand the above information. I have asked all questions and have had my questions answered. I agree to participate in this study. I will be provided with a copy of this form for my records.

_____
Participant's Name (please print)

_____ _____
Participant's Signature Date

_____ _____
Researcher's Signature Date

APPENDIX B - IRB REQUEST (EXPERIMENT 1)

C. Neil Fitzpatrick, Capt/USMC
Ümit Ayvaz, Capt/Turkish Army
MOVES
Watkins Hall
Naval Postgraduate School
Monterey, California 93943

cnfitzpa@nps.edu
(831) 917-6663

uayvaz@nps.edu
(831)-393-1272

To: Protection of Human Subjects Committee

Subject: Application for Human Subjects Review (Title): The most appropriate time and method for becoming comfortable with the Tactical Decision-Making Simulation (TDS) controls.

1. Attached is a set of documents outlining a proposed experiment to be conducted by C. Neil Fitzpatrick (Captain USMC) and Ümit AYVAZ (Captain Turkish Army) for their final project in OA3402 Research Methods in Performance Assessment class in HSIL lab in Glasgow Hall.

2. We are requesting approval of the described experimental protocol. For your reference, an experimental outline is included that describes the methods and measures we plan to use.

3. We include the consent forms, privacy act statements, all materials and forms that a subject will read or fill-out, and the debriefing forms (if applicable) we will be using in the experiment.

4. We understand that any modifications to the protocol or instruments/measures will require submission of updated IRB paperwork and possible re-review. Similarly, we understand that any untoward event or injury that involves a research participant will be reported immediately to the IRB Chair and NPS Dean of Research.

Dr. Amela Sadagic, Principal Investigator (PI)

C. Neil Fitzpatrick, Student Researcher

Ümit AYVAZ, Student Researcher

APPLICATION FOR HUMAN SUBJECTS REVIEW (HSR)	HSR NUMBER *(to be assigned)*
PRINCIPAL INVESTIGATOR(S) *(Full Name, Code, Telephone)* Dr. Amela Sadagic, MOVES Research Associate Professor, 831.656.3819	
APPROVAL REQUESTED [X] New [ ] Renewal	
LEVEL OF RISK [ ] Exempt [X] Minimal [ ] More than Minimal Justification:	
WORK WILL BE DONE IN GLASCOW Human Systems Integration Lab.	ESTIMATED NUMBER OF DAYS TO COMPLETE 5 days
MAXIMUM NUMBER OF SUBJECTS 15	ESTIMATED LENGTH OF EACH SUBJECT'S PARTICIPATION 300 minutes
SPECIAL POPULATIONS THAT WILL BE USED AS SUBJECTS [ ] Subordinates [ ] Minors [X] NPS Students [ ] Special Needs (e.g. Pregnant women) Specify safeguards to avoid undue influence and protect subject's rights:	
OUTSIDE COOPERATING INVESTIGATORS AND AGENCIES [ ] A copy of the cooperating institution's HSR decision is attached.	

TITLE OF EXPERIMENT AND DESCRIPTION OF RESEARCH (attach additional sheet if needed).

Introduction to Tactical Decision-Making Simulations (TDS): Pointing and Clicking

INTRODUCTION

We will use the Human Systems Integration Laboratory (HISL) to conduct an experiment examining 3 different training methods. We will evaluate training approaches for operating a Tactical Decision-Making Simulation (TDS). The TDS is called Close Combat Marine (CCM) version 4.0 and is a virtual environment (a simulation) used by the USMC to train Marines in tactical decision-making. Researchers will provide the participants with a brief (no more than 5 minutes) explanation of the TDS and how they will participate in the simulation.

We will administer and collect user computer simulation experience and demographics in the form of a Pre-TDS questionnaire prior to the commencement of Phase I.

The overall study will be divided into 3 phases:

PHASE I

Participants will engage in one of the 3 TDS training methodologies to learn how to operate the TDS. Phase I scenarios will include:

a) TDS Boot Camp scenario alone (provided by the TDS manufacturer),
b) TDS Boot Camp scenario with memory-sheet,
c) Memory-sheet alone with a practice scenario (user progresses at his own pace and asks questions of researchers if he gets stuck).

This phase will last approximately 30 minutes.

PHASE II

All participants, regardless of Phase I grouping, will all go through the same phase II scenarios to provide a baseline for comparison of the different groups.

PHASE III

Phase III is the final phase of the study. The researchers will administer a Post-TDS participant survey. Each participant will go through only one of the scenarios for Phase I and one scenario for Phase II for a total of 2 scenarios.

The researchers will record participants' actions using a video camera (Note: participants themselves will not appear in the video.) The recording of sessions will be both audio and video. Again, the user's image will not appear in the video. The video will record the computer screen that the participant/user is interacting. This video will be used afterwards to evaluate the efficacy of the training method. The number of mistakes will be one of the objective metrics used to determine how well the participants learned the task.

The researchers will, also, subjectively evaluate each participant on his/her performance using a Likert scale.

I have read and understand NPS Notice on the Protection of Human Subjects. If there are any changes in any of the above information or any changes to the attached Protocol, Consent Form, or Debriefing Statement, I will suspend the experiment until I obtain new Committee approval.

SIGNATURE_____ , PI

SIGNATURE_____ , Student Researcher

SIGNATURE_____ , Student Researcher

DATE_____

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APPENDIX C - SURVEY (EXPERIMENT 1)

Pre-TDS Survey

Please fill in the following questionnaire. Answer all questions as objectively as you can. All information will be held confidential.

If you need to expand any answer please use the reverse side of your paper sheet.

SIMULATION EXPERIENCE

1. Were you required to use computer-based training simulations as part of your training in the past?

YES / **NO** (circle one)

a. If **YES**:

1) What type simulations have you used and what skills were they used to train?

1. Tactical level Describe it:	2. Operational level Describe it:	3. Strategic level Describe it:

2) Tactical: What was the total number of hours you were expected to use them (estimate)? _____ hours

Operational: What was the total number of hours you were expected to use them (estimate)? _____ hours

Strategic: What was the total number of hours you were expected to use them (estimate)? _____ hours

3) That number of hours was (circle one number on the scale from 1 to 5) to acquire a good skill level:

1 = not at all sufficient	**2** = less than sufficient	**3** = sufficient	4 = more than sufficient	**5** = Totally sufficient

4) Add any comment you'd like to justify that answer:

_____

_____

2. Do you have experience with playing commercial video games? **YES** / **NO** (circle one)

3. If **YES**,

a) What kind of video games do you play? (circle all that apply)

1. first person shooter	2. flight simulations	3. racing	4. other sports	5. puzzle, strategy, card, board	6. adventure, fantasy, role playing	7. online multiplayer games	8. arcades	9. other

b) How often do you play them?

Circle one: **several times a week** / **once a week** / **several times a month** / **once a month** / **several times a year**

c) That is about _____ (number) hours per: **day** / **week** / **month** / **year** (circle one).

4. Do you have your own personal computer or access to a computer that you can use on a daily basis? **YES** / **NO** (circle one)

a. If **YES**, how long have you been using it on daily basis? For _____ (number) years and _____ (number) months.

5. What hand do you use to operate a computer mouse? **LEFT** / **RIGHT** / **I am good with either** (circle one)

6. How often do you use email, browse the web, or use some other computer applications? (circle the answer in bold that applies to you)

	Knowledge and skills:		**Your current level** Monthly (Infrequent)				Daily (Very Frequent)
A.	Email	after school hours (private use)	**1**	**2**	**3**	**4**	**5**
		at school (in the unit)	**1**	**2**	**3**	**4**	**5**
B.	Browse the web	after school hours (private use)	**1**	**2**	**3**	**4**	**5**
		at school (in the unit)	**1**	**2**	**3**	**4**	**5**
C.	Office automation (Word, Excel, PPT)	after school hours (private use)	**1**	**2**	**3**	**4**	**5**
		at school (in the unit)	**1**	**2**	**3**	**4**	**5**
D.	_____ (some other application - which?)	after school hours (private use)	**1**	**2**	**3**	**4**	**5**
		at school (in the unit)	**1**	**2**	**3**	**4**	**5**
E.	_____ (some other application - which?)	after school hours (private use)	**1**	**2**	**3**	**4**	**5**
		at school (in the unit)	**1**	**2**	**3**	**4**	**5**

7. When you think about <u>your own</u> knowledge of the procedures, and your current skills, how would you rank them?

#	**Knowledge and skills:**	□**Your current level** worst best				□
1.	Familiarity with a five paragraph order	**1**	**2**	**3**	**4**	**5**
2.	Employ Machine guns in support of Offensive Operations	**1**	**2**	**3**	**4**	**5**
3.	Employ Machine guns in support of Defensive Operations	**1**	**2**	**3**	**4**	**5**
4.	Conduct a Infantry Squad/Platoon Attack	**1**	**2**	**3**	**4**	**5**
5.	Control tactical movement of a Squad/Platoon in the Offense	**1**	**2**	**3**	**4**	**5**
6.	Conduct a Squad/Platoon Attack on Urban Terrain	**1**	**2**	**3**	**4**	**5**
7.	Conduct a Squad/Platoon Defense on Urban Terrain	**1**	**2**	**3**	**4**	**5**

DEMOGRAPHICS

1. **Subject#** = (You will be provided with a uniquely coded number) : _____

2. Date: _____ Time: _____

3. Year of birth: _____

4. Country of Citizenship:_____

5. Service component: (circle one) Army Navy Air Force Marine Corps Coast Guard Civilian

6. Briefly describe your Primary MOS, (Example: Infantry, Surface Warfare, communications, etc):

_____

7. NPS Curriculum: _____

8. Your Rank: _____

9. Total number of months in service: _____

Thank you very much for participating in the study. Relax and Enjoy!

Post-TDS Survey

1. Date: _____ Time: _____

2. **Subject#** = (You will be provided with a uniquely coded number) : _____

3. What training methodology was administered during your session: (please check only one block)

1.	Group 1	
2.	Group 2	
3.	Group 3	

4. That amount of time for me to acquire a skill level adequate to participate in the simulation was: (Circle one number on the scale from 1 to 5.)

1 = not at all sufficient	**2** = less than sufficient	**3** = sufficient	4 = more than sufficient	**5** = Totally sufficient

5. If you did not have enough time to become familiar with the TDS, how much more time do you believe you would need?

_____

6. How satisfied were you with your overall performance while using the CCM TDS:

1 = not at all satisfied	**2** = less than satisfied	**3** = satisfied	**4** = somewhat satisfied	**5** = Extremely satisfied

7. When you think about your own knowledge of tactical procedures and your current skill level, how would you rank them now after the TDS scenario?

#	**Knowledge and skills:**	**□Your current level** worst				□ best
	Familiarity with a five paragraph order	**1**	**2**	**3**	**4**	**5**
	Employ Machine guns in support of Offensive Operations	**1**	**2**	**3**	**4**	**5**
	Employ Machine guns in support of Defensive Operations	**1**	**2**	**3**	**4**	**5**
	Conduct a Infantry Squad/Platoon Attack	**1**	**2**	**3**	**4**	**5**
	Control tactical movement of a Squad/Platoon in the Offense	**1**	**2**	**3**	**4**	**5**
	Conduct a Squad/Platoon Attack on Urban Terrain	**1**	**2**	**3**	**4**	**5**
	Conduct a Squad/Platoon Defense on Urban Terrain	**1**	**2**	**3**	**4**	**5**

Thanks very much for participating!

APPENDIX D - CCM MEMORY SHEET (EXPERIMENT 1)

Close Combat Marines (CCM)

Desired Action

Selection/Deselect Units

Select Troops — Left Click on Unit
Unselect Troops — Left Click on another part of the screen

Issue Orders

Right Click on Unit to display the orders menu >> Left Click on desired order
(Only orders that are available will be displayed.) Adot is placed on the battle field to indicate the location/destination of your order.

Move – Team members will walk
Move Fast – Team members will run
Move Covert – Team member will crawl and then defend when they arrive at destination
Fire – Commands your team to commence firing. Left click on target.
Bright Green line: Your team can see its target.
Dark Green line: Sight blocked, but can still shoot.
Red line: Shoot is blocked
Smoke – Delivers smoke to a location to screen movements
Defend – Troops set into a defensive posture
Ambush – Troops find cover and fire only if enemy is very close
Mount/Dismount – either get into or out of vehicles
Dig – Troops dig and get into a fighting hole

Screen Navigation

Use Map Monitor (Thumbnail Display) Left Click on the small map to jump to any location on the battlefield.
Use Mouse and Keyboard
Move Viewpoint Up — Up Arrow or move cursor to top edge of screen
Move Viewpoint Down — Down Arrow or move cursor to bottom edge of screen
Move Viewpoint Right — Right Arrow or move cursor to right edge of screen
Move Viewpoint Left — Left Arrow or move cursor to left edge of screen

Display Detailed Terrain Information

- Right click on terrain and HOLD. Message will appear in lower left corner.

Toggle Trees on/off — Ctrl+t

Monitors and Toolbars

(All game information is located at bottom of screen in toolbars.
Turn them on & off with buttons at bottom left portion of the toolbar)

You can:
Monitor Morale
Conduct Air Strikes with Fixed Wing/Rotary Wing
(Left click on the Air Icon, then left click on the location where it is to be delivered.)
Conduct Artillery Barrage
(Left Click Artillery Icon and then left click where you want ordinance delivered on screen
Conduct Mortar Barrage
Monitor Team Status (Left Click on team to get individual team member's:
-names
-health and morale
-billet.

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APPENDIX E - STATISTICAL ANALYSIS (EXPERIMENT 1)

Experiment Hypothesis Test

H_0 = There is NO difference between the methods.

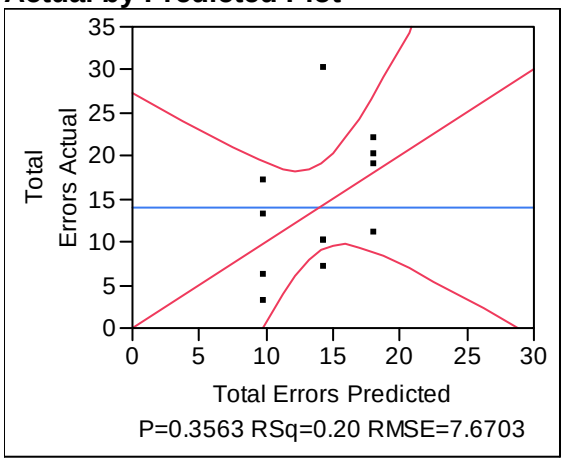
H_a = There is a difference between the methods.

We used F (ANOVA) test for our first experiment. This is because we had 3 groups of people. The researchers chose an $\alpha = 0.05$ as the significance criteria whether to reject the null hypothesis.

Since p = 0.2241, which is greater than $\alpha = 0.05$, we are not able to reject Ho. We conclude that there is no significant difference between the 3 methods.

Methods vs. Total Errors

Actual by Predicted Plot

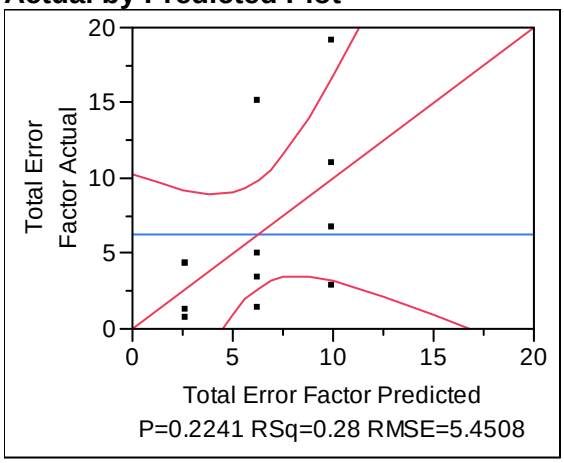


Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	2	136.50000	68.2500	1.1601
Error	9	529.50000	58.8333	**Prob > F**
C. Total	11	666.00000		0.3563

Method vs. Total Error Factor

Whole Model
Actual by Predicted Plot



Analysis of Variance

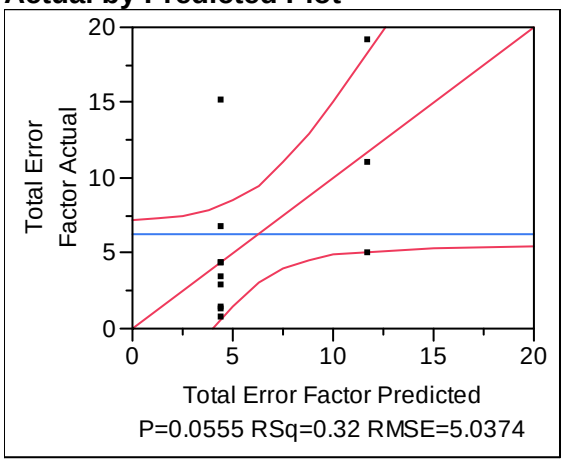
Source	DF	Sum of Squares	Mean Square	F Ratio
Model	2	105.42002	52.7100	1.7741
Error	9	267.39828	29.7109	**Prob > F**
C. Total	11	372.81829		0.2241

Other Findings

For the following plots, we found that there was a significant correlation between Gender and Total Error Factor, as well as, Gaming Experience and Total Error Factor.

Gender vs. Total Error Factor

Actual by Predicted Plot

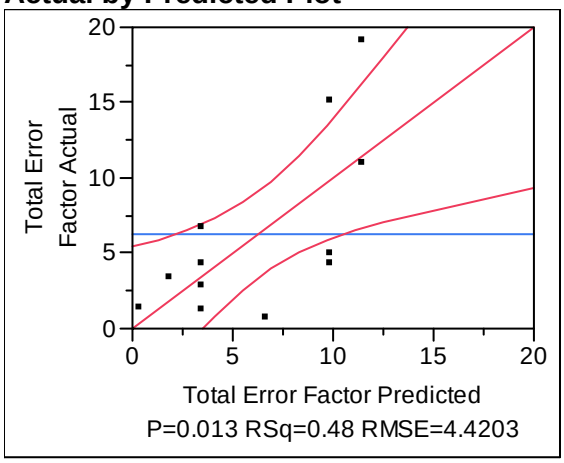


Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	119.06447	119.064	4.6921
Error	10	253.75382	25.375	**Prob > F**
C. Total	11	372.81829		0.0555

Gaming Experience vs. Total Error Factor

Actual by Predicted Plot

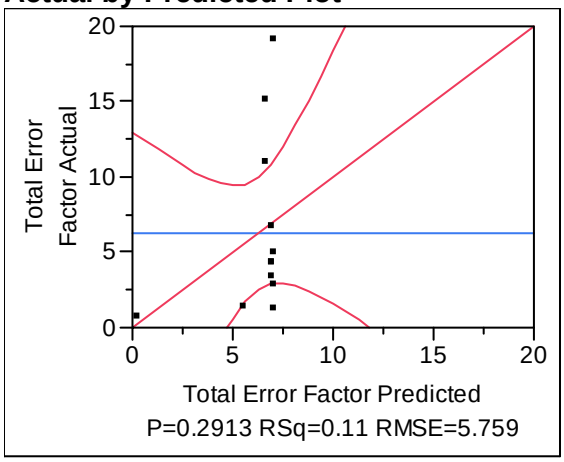


Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	177.42417	177.424	9.0803
Error	10	195.39412	19.539	**Prob > F**
C. Total	11	372.81829		0.0130

Simulation Experience

Actual by Predicted Plot

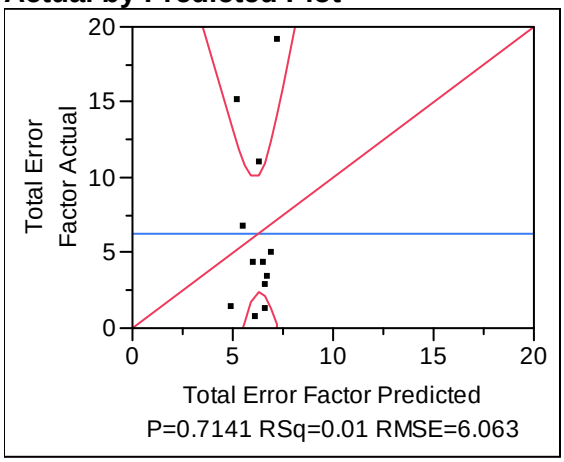


Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	41.15848	41.1585	1.2410
Error	10	331.65981	33.1660	**Prob > F**
C. Total	11	372.81829		0.2913

Time In Service (TIS)

Actual by Predicted Plot



Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	5.22407	5.2241	0.1421
Error	10	367.59423	36.7594	**Prob > F**
C. Total	11	372.81829		0.7141

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APPENDIX F - CONSENT FORM (EXPERIMENT 2)

Naval Postgraduate School

Participant Consent Form &
Minimal Risk Statement

Introduction. You are invited to participate in a study that will compare the training effectiveness of a Tactical Decision-Making Simulation (TDS) and a Tactical Decision-Making Game (TDG). This will be conducted by the Naval Postgraduate School Modeling of Virtual Environments and Simulation (MOVES) Institute.

Procedures. We will use a lab in Watkins Hall (212a) to conduct this experiment examining these 2 different training approaches. The TDS that will be used is called Close Combat Marine (CCM) version 4.0 and is a virtual environment (a simulation) used by the USMC to train Marines in tactical decision-making. The researchers will provide the participants with a briefing during Session I. This will describe the number of sessions and the basic skills that will be necessary to complete both the TDS and the TDG. We will collect user computer simulation experience and demographics in the form of a questionnaire prior to Session I. Participants will be divided into a TDG group (8 participants) and a TDS group (8 participants) and remain in those groups for the duration of the experiment. Each of these will be further subdivided into 2 groups of 4 each.

Session I TDS and TDG will be centered on a tactical situation within a small town. Participants will be taught the necessary tactics that will be used in the sessions. In the TDS session, participants will be informed about what the TDS is and how to operate it. The TDG group will be introduced to the nature of a TDG by participating in an abbreviated TDG session. Both TDS and TDG sessions will last approximately 60 minutes for both groups.

In Sessions 2, 3, 4, and 5, the TDS participants will go through a different scenario each time. TDS users will alternate between playing the offense and the defense, changing roles after each session. TDG users will all be offense or defense during a single session and switch roles for the next session. The researchers will administer questionnaires after each session.

The researchers will record some of the participants' actions using a video camera, but will not tie user demographic information to the video. Participants will not be identifiable by name, country, etc. The video tape will be destroyed upon completion of the experiment.

Risks and Benefits. I understand that this project does not involve greater than minimal risk and involves no known reasonably foreseeable risks or hazards greater than those encountered in everyday life. I have, also, been informed of any benefits to myself or to others that may reasonably be expected as a result of this research.

Compensation. I understand that participation in this study will earn me some class credit in my OA3101 course and that the amount of my participation will be provided to my instructor (Col L. Shattuck). A copy of the research results will be available at the conclusion of the experiment if I would like to have a copy of them.

Confidentiality & Privacy Act. I understand that all records of this study will be kept confidential and that my privacy will be safeguarded. No information will be publicly accessible which could identify me as a participant, and I will be identified only as a code number on all research forms. I understand that records of my participation will be maintained by NPS for 5 years, after which they will be destroyed.

Voluntary Nature of the Study. I understand that my participation is strictly voluntary, and if I agree to participate, I am free to withdraw at any time without prejudice.

Points of Contact. I understand that if I have any questions or comments regarding this project upon the completion of my participation, I should contact the Principal Investigator, C. Neil Fitzpatrick, Capt/USMC, (831) 917-6663, cnfitzpa@nps.edu, or Ümit Ayvaz, Capt/Turkish Army, uayvaz@nps.edu. Any medical questions should be addressed to LTC Eric Morgan, MC, USA, (CO, POM Medical Clinic), (831) 242-7550, eric.morgan@nw.amedd.army.mil.

Statement of Consent. I have read and understand the above information. I have asked all questions and have had my questions answered. I agree to participate in this study. I will be provided with a copy of this form for my records.

_____
Participant's Name (please print)

_____ _____
Participant's Signature Date

_____ _____
Researcher's Signature Date

APPENDIX G - IRB REQUEST (EXPERIMENT 2)

Amela Sadagic, PhD
C. Neil Fitzpatrick, Capt/USMC
Ümit Ayvaz, Capt/Turkish Army
MOVES
Watkins Hall
Naval Postgraduate School
Monterey, California 93943

asadagic@nps,edu
(831) 656-3819

cnfitzpa@nps.edu
(831) 917-6663

uayvaz@nps.edu
(831)-393-1272

To: Protection of Human Subjects Committee

Subject: Comparison of the Training Effectiveness of a Tactical Decision-Making Simulation (TDS) and a Tactical Decision-Making Game (TDG).

Attached is a set of documents outlining a proposed experiment to be conducted by C. Neil Fitzpatrick (Captain USMC) and Ümit AYVAZ (Captain Turkish Army) for their pilot study for their thesis in a Lab in Watkins Hall (212a).

1. We are requesting approval of the described experimental protocol. An experimental outline is included for your reference that describes the methods and measures we plan to use.

2. We include the consent forms, privacy act statements, all materials and forms that a subject will read or fill-out, and the debriefing forms (if applicable) we will be using in the experiment.

3. We understand that any modifications to the protocol or instruments/measures will require submission of updated IRB paperwork and possible re-review. Similarly, we understand that any untoward event or injury that involves a research participant will be reported immediately to the IRB Chair and NPS Dean of Research.

The work on this study is a part of NMSO sponsored project (R9D8S) with title: "Studying the Synergy of Virtual Training Simulations and Novel Training Methodologies for Training of the Ground Officers, and Evaluation of Training Effectiveness."

Dr. Amela Sadagic, Principal Investigator (PI)

C. Neil Fitzpatrick, Student Researcher

Ümit AYVAZ, Student Researcher

APPLICATION FOR HUMAN SUBJECTS REVIEW (HSR)	HSR NUMBER *(to be assigned)*
PRINCIPAL INVESTIGATOR(S) *(Full Name, Code, Telephone)* Dr. Amela Sadagic, MOVES Research Associate Professor, 831.656.3819	
APPROVAL REQUESTED [X] New [ ] Renewal	
LEVEL OF RISK [ ] Exempt [X] Minimal [ ] More than Minimal Justification: The subjects in the study will be asked to use virtual training simulation on desktop computer (they will also use computer mouse and keyboard) and fill in several questionnaire forms.	
WORK WILL BE DONE IN Watkins Hall Lab in Watkins Hall (212a)	ESTIMATED NUMBER OF DAYS TO COMPLETE 30 days
MAXIMUM NUMBER OF SUBJECTS 16	ESTIMATED LENGTH OF EACH SUBJECT'S PARTICIPATION 300 minutes total (5 sessions where 1 session is held on one day, 60 min each session)
SPECIAL POPULATIONS THAT WILL BE USED AS SUBJECTS [ ] Subordinates [ ] Minors [X] NPS Students [ ] Special Needs (e.g. Pregnant women) Specify safeguards to avoid undue influence and protect subject's rights: The participation in the study is voluntary and will not be imposed on any NPS student: each person will have an option of withdrawing from the study at any point in time. The data collected in the study will be safeguarded as requested by generally accepted IRB standards: each person will be identified only as a code number on all research forms/data bases; name of any person on any signed document will not be paired with their code number in order to protect their identity; and records of subject's participation will be maintained by NPS for 3 years, after which they will be destroyed.	
OUTSIDE COOPERATING INVESTIGATORS AND AGENCIES [ ] A copy of the cooperating institution's HSR decision is attached.	

TITLE OF EXPERIMENT AND DESCRIPTION OF RESEARCH (attach additional sheet if needed).

COMPARISON OF THE TRAINING EFFECTIVENESS OF A TACTICAL DECISION-MAKING SIMULATION (TDS) AND A TACTICAL DECISION-MAKING GAME (TDG)

INTRODUCTION

We will use the Lab in Watkins Hall (212a) to conduct a study that will compare the training effectiveness of a Tactical Decision-Making Simulation (TDS) and a Tactical Decision-Making Game (TDG). The TDS is called Close Combat Marine (CCM) version 4.0 and is a virtual environment (a simulation) used by the USMC to train Marines in tactical decision making.

Participants will be divided into a TDG group (8 participants) and a TDS group (8 participants) and remain in those groups for the duration of the experiment. Each of these will be further subdivided into 2 groups of 4 each.

The overall study will be divided up into 5 sessions both for the TDG and the TDS group:

SESSION 1

The researchers will collect user computer simulation experience and demographics in the form of a questionnaire prior to Session I. The researchers will provide both TDG and TDS participants with a briefing during Session I. This will describe the number of sessions and the basic skills that will be necessary to complete both the TDS and the TDG. In this session, TDS and TDG will be centered on a tactical situation within a small town. In the TDS session, participants will be informed about what the TDS is and how to operate it. The TDG group will be introduced to the nature of a TDG by participating in an abbreviated TDG session.
Both TDS and TDG sessions will last approximately 60 minutes.

SESSION 2, 3, 4, AND 5:

The TDS participants will go through a different scenario each time. TDS users will alternate between playing the offense and the defense, changing roles after each session. TDG users will all be offense or defense during a single session and switch roles for the next session. The researchers will administer questionnaires after each session, as well as a final questionnaire after Session 5 in both TDS and TDG. Both TDS and TDG sessions will last approximately 60 minutes.

The researchers will record some of the participants' actions using a video camera, but will not tie user demographic information to the video. Participants will not be identifiable by name, country, etc. The video tape will be destroyed upon completion of the experiment, but

digital recordings (values recorded by the CCM training simulation) will be retained for the purposed of training and follow-on work.

The researchers will, also, evaluate each participant on their ability to lead a group, to make tactically sound and timely decisions, and their situational awareness in the TDS and TDG scenarios.

I have read and understand NPS Notice on the Protection of Human Subjects. If there are any changes in any of the above information or any changes to the attached Protocol, Consent Form, or Debriefing Statement, I will suspend the experiment until I obtain new Committee approval.

SIGNATURE_____ , PI

SIGNATURE_____ , Student Researcher

SIGNATURE_____ , Student Researcher

DATE_____

APPENDIX H - TDG SURVEY (EXPERIMENT 2)

Pilot Study Survey

- TDG Session 1 -

Pre-questionnaire

Please fill in the following questionnaire. Answer all questions as objectively as you can. All information will be held confidential.

If you need to expand any answer please use the reverse side of your paper sheet.

---

1) Were you required to use computer-based simulations as part of your training in the past? **NO** / **YES** (circle one)

a) **NO.**

b) If YES: What type simulations have you used and what skills were they used to train?

i) Tactical Level (Marksmanship trainer, ship driving simulator, Language Trainer, etc.)

(1) Description:

_____

_____

_____

_____

_____

(2) Estimate total number of hours you used it: _____

(3) To gain competency, this amount of time spent was: (Circle one)

1 = Not Satisfactory	**2**	**3**	**4 =Average**	**5**	**6**	**7 = Excellent**

i) Operational Level (OneSAF, JSAF, JCATS, Common Operational Picture of the Battlespace, etc.)

(1) Description:

_____

_____

_____

_____

_____

(2) Estimate total number of hours you used it: _____

(3) To gain competency, this amount of time spent was: (Circle one)

1 = Not Satisfactory	**2**	**3**	**4 =Average**	**5**	**6**	**7 = Excellent**

2) Do you have experience playing commercial video games? **NO** / **YES** (circle one)

a) **NO.**

b) If **YES**, What kind of video games do you play? (answer all that apply to you; circle day, week, month or year in each line)

i) First person shooter. (Stand Alone or Online) Approximately _____ hours per **day** / **week** / **month** / **year**

ii) Flight Simulation. (Stand Alone or Online) Approximately _____ hours per **day** / **week** / **month** / **year**

iii) Racing. (Stand Alone or Online) Approximately _____ hours per **day** / **week** / **month** / **year**

iv) Sports (Football, etc.) (Stand Alone or Online) Approximately _____ hours per **day** / **week** / **month** / **year**

v) Puzzle, Card, Board (Stand Alone or Online) Approximately _____ hours per **day** / **week** / **month** / **year**

vi) Strategy (Stand Alone or Online) Approximately _____ hours per **day** / **week** / **month** / **year**

vii) Adventure, Fantasy (Stand Alone or Online) Approximately _____ hours per **day** / **week** / **month** / **year**

viii) Arcade (Stand Alone or Online) Approximately _____ hours per **day** / **week** / **month** / **year**

ix) Other (Stand Alone or Online) Approximately _____ hours per **day** / **week** / **month** / **year**

3) Do you own a personal computer? **NO** / **YES** (circle one)

a) **NO.**

b) If **YES**, how often do you use it? Approximately _____ hours per **day** / **week** / **month** / **year**

4) What hand do you use to operate a computer mouse? **LEFT** / **RIGHT** / **I am good with either** (circle one)

5) How often do you use the following other computer applications? (please answer all that apply to you; circle day, week, month or year in each line)

i) E-mail: Approximately _____ hours per **day** / **week** / **month** / **year**

ii) Browse Web: Approximately _____ hours per **day** / **week** / **month** / **year**

iii) IMovie: Approximately _____ hours per **day** / **week** / **month** / **year**

iv) ITunes: Approximately _____ hours per **day** / **week** / **month** / **year**

v) Excel: Approximately _____ hours per **day** / **week** / **month** / **year**

vi) Word: Approximately _____ hours per **day** / **week** / **month** / **year**

vii) Power point: Approximately _____ hours per **day** / **week** / **month** / **year**

6) When you think about your own knowledge of infantry tactics, techniques, and procedures, how would you rank them? (please circle NA or one number between 1 and 7 in each line)

#	Knowledge and skills:		☐ Poor			Your current level			☐ Excellent
1.	Familiarity with a five paragraph order	NA	1	2	3	4	5	6	7
2.	Employ Machine guns in support of Offensive Operations	NA	1	2	3	4	5	6	7
3.	Employ Machine guns in support of Defensive Operations	NA	1	2	3	4	5	6	7
4.	Infantry Offensive Operations in Field	NA	1	2	3	4	5	6	7
5.	Infantry Defensive Operations in Field	NA	1	2	3	4	5	6	7
6.	Tactical Movement On Objective	NA	1	2	3	4	5	6	7
7.	Fire and Maneuver	NA	1	2	3	4	5	6	7
8.	Infantry Attack in Urban Terrain	NA	1	2	3	4	5	6	7
9.	Infantry Defense in Urban Terrain	NA	1	2	3	4	5	6	7
10.	Issue an Order	NA	1	2	3	4	5	6	7
11.	Conduct Tactical Movement in the Offense	NA	1	2	3	4	5	6	7

7) Subject# (your code name): _____

8) Date: _____ Time: _____

9) Year of birth: _____

10) Country of Citizenship: _____

11) Service component: (Circle one)

Army	Navy	Air Force	Marine Corps	Coast Guard	Civilian

12) Briefly describe your Primary MOS, (Example: Infantry, Surface Warfare, communications, etc.):

_____

13) NPS Curriculum: _____

14) Your Rank: _____

15) Time in Service: _____ years _____ months

Thank you very much for participating in the study.

Pilot Study Survey

- TDG Session 2 -

Questionnaire

Please fill in the following questionnaire. Answer all questions as objectively as you can.

All information will be held in confidence.

If you need to expand any answer please use the reverse side of your paper.

Participant # = (Your code name) : _____

Date: _____ Time: _____

1) What training group were you in? (Circle One)

a. Offense

b. Defense

2) For each person (including yourself) give a score between 0 and 100 which estimates the degree to which that person was the 'leader' in the last training session. (The four scores must add to 100).

(For example, if no clear leader emerged, then each should have a score of 25. If Person X played the major role in this regard, then Person X would have a score of say 80, and the other 2 people, a score of 10 each. A score of 0 means that the corresponding person was in no way a leader; whereas a score of 100 means that the corresponding person was the clear and only leader.)

Person (code name):	**Score/100:**
Total Score:	**100**

3) Think about a previous time when you *enjoyed* working together in a group. To what extent have you *enjoyed* the group experience just now?

I enjoyed the group experience just now (please check one number between 1 and 7):

1. Not at all		It was nothing like the previous experience of working in a group.
2.		
3.		
4.		
5.		
6.		
7. Very much so.		I enjoyed it just as much as the previous experience of working in a group.

4) Think back now about the session that you have just completed. For example, to what extent in your imagination can you move around that terrain (battlefield) now?

I can think myself back on that terrain/battlefield (please check one number between1 and 7):

1. Not at all		I cannot imagine now at all being on that terrain/battlefield now.
2.		
3.		
4.		
5.		
6.		
7. Very much so.		I can strongly imagine being back on that terrain/battlefield now.

5) In the last session, to what extent did you have the sense of the other three people being <u>together with you</u>*?*

In the last session, I had a sense that the other three people were with me (please check one number between 1 and 7):

1. Not at all		I did not have a sense that the other three people were with me.
2.		
3.		
4.		
5.		
6.		
7. Very much so.		The other three people were very much with me.

6) Who did most of the talking? Give a score to each person between 0 and 100, where the four scores add to 100. (A person would be given a score of near 100 only if they did almost all the talking. They would be given a score of near 0 if they did almost no talking).

The extent to which each person did most of the talking was:

Person (code name):	**Score/100:**
Total Score:	**100**

7) Overall, how cooperative was each of the other three people (please check one value between 1 and 7 for each person).

Person (code name) →				
1. Not at all				S/he was not cooperative at all
2.				
3.				
4.				
5.				
6.				
7. Very much so.				S/he was very cooperative

8) Think back now about past session, what were <u>good</u> tactical decision and procedures done by <u>your</u> team?

_____

_____

_____

9) Think back now about past session, what were bad tactical decision and procedures done by your team?

10) Think back now about past session, what were good tactical decision and procedures done by other team?

11) Think back now about past session, what were bad tactical decision and procedures done by other team?

_____

_____

_____

_____

_____

_____

12) What can you say about:

a) Team Member #1, (Participant's code name:_____) where Poor (1) - Excellent (7). (please circle NA or one number between 1 and 7 in each line)

#	**Knowledge and skills:**		**Your current level** ☐ poor Excellent						
1.	Understood Operations Order	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
2.	Identified Enemy Most Probably Course of Action (MPCOA)	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
3.	Created a Scheme of Maneuver (SOM)	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
4.	Considers Adjacent Units	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
5.	Created a Fire Support Plan (FSP)	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
6.	Identified Secondary MPCOA	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
7.	Considered the following in Mission Planning Process:								
7.a	- Mission	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
7.b	- Enemy	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
7.c	- Troops Available	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
7.d	- Terrain	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
7.e	- Time	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
8.	Identified Enemy of Center of Gravity and Attacks It.	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
9.	Adjusted to Enemy Situation	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
10.	Took Charge	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
11.	Maintained Oversight of All Subordinate Units	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
12.	Communicated His Plan/Intent to Subordinates	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
13.	Ensured that Subordinates what they had been told	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**

#	Knowledge and skills:		☐Your current level ☐ poor Excellent						
14.	Used deception and creativity to outwit the enemy	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
15.	Deviated from doctrine when necessary	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
16.	Enemy Location	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
17.	Size of Enemy Element	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
18.	Direction of Enemy Movement	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
19.	Understanding of Battle Space Geometry	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**

b) Team Member #2, (Participant's code name: _____) where Poor (1) - Excellent (7). (please circle NA or one number between 1 and 7 in each line)

#	Knowledge and skills:		☐Your current level ☐ poor Excellent						
1.	Understood Operations Order	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
2.	Identified Enemy Most Probably Course of Action (MPCOA)	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
3.	Created a Scheme of Maneuver (SOM)	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
4.	Considers Adjacent Units	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
5.	Created a Fire Support Plan (FSP)	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
6.	Identified Secondary MPCOA	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
7.	Considered the following in Mission Planning Process:								
7.a	- Mission	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
7.b	- Enemy	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
7.c	- Troops Available	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
7.d	- Terrain	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
7.e	- Time	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
8.	Identified Enemy of Center of Gravity and Attacks It.	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
9.	Adjusted to Enemy Situation	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
10.	Took Charge	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
11.	Maintained Oversight of All Subordinate Units	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
12.	Communicated His Plan/Intent to Subordinates	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
13.	Ensured that Subordinates what they had been told	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
14.	Used deception and creativity to outwit the enemy	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**

#	Knowledge and skills:		☐Your current level ☐ poor Excellent						
15.	Deviated from doctrine when necessary	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
16.	Enemy Location	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
17.	Size of Enemy Element	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
18.	Direction of Enemy Movement	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
19.	Understanding of Battle Space Geometry	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**

c) Team Member #3, (Participant's code name: _____), where Poor (1) - Excellent (7). (please circle NA or one number between 1 and 7 in each line)

#	Knowledge and skills:		☐Your current level ☐ poor Excellent						
1.	Understood Operations Order	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
2.	Identified Enemy Most Probably Course of Action (MPCOA)	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
3.	Created a Scheme of Maneuver (SOM)	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
4.	Considers Adjacent Units	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
5.	Created a Fire Support Plan (FSP)	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
6.	Identified Secondary MPCOA	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
7.	Considered the following in Mission Planning Process:								
7.a	- Mission	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
7.b	- Enemy	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
7.c	- Troops Available	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
7.d	- Terrain	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
7.e	- Time	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
8.	Identified Enemy of Center of Gravity and Attacks It.	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
9.	Adjusted to Enemy Situation	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
10.	Took Charge	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
11.	Maintained Oversight of All Subordinate Units	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
12.	Communicated His Plan/Intent to Subordinates	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
13.	Ensured that Subordinates what they had been told	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
14.	Used deception and creativity to outwit the enemy	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
15.	Deviated from doctrine when necessary	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**

#	Knowledge and skills:		Your current level ☐ poor Excellent						
16.	Enemy Location	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
17.	Size of Enemy Element	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
18.	Direction of Enemy Movement	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
19.	Understanding of Battle Space Geometry	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**

13) YOURSELF on the following criteria where Poor (1) - Excellent (7). (please circle NA or one number between 1 and 7 in each line)

#	Knowledge and skills:		Your current level ☐ poor Excellent						
1.	Understood Operations Order	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
2.	Identified Enemy Most Probably Course of Action (MPCOA)	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
3.	Created a Scheme of Maneuver (SOM)	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
4.	Considers Adjacent Units	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
5.	Created a Fire Support Plan (FSP)	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
6.	Identified Secondary MPCOA	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
7.	Considered the following in Mission Planning Process:								
7.a	- Mission	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
7.b	- Enemy	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
7.c	- Troops Available	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
7.d	- Terrain	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
7.e	- Time	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
8.	Identified Enemy of Center of Gravity and Attacks It.	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
9.	Adjusted to Enemy Situation	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
10.	Took Charge	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
11.	Maintained Oversight of All Subordinate Units	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
12.	Communicated His Plan/Intent to Subordinates	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
13.	Ensured that Subordinates what they had been told	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
14.	Used deception and creativity to outwit the enemy	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
15.	Deviated from doctrine when necessary	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
16.	Knew Enemy Location	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**

#	Knowledge and skills:		☐Your current level ☐ poor Excellent						
17.	Knew the Size of the Enemy Element	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
18.	Knew the Direction of the Enemy's Movement	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
19.	Understood the Battle Space Geometry	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**

14) If you did not have enough time to become familiar with the infantry tactics of the offense or defense (whichever you participated in), how much more time do you believe you would need?

_____

_____

15) How satisfied were you with your overall performance while participating in the TDG:

1 = Not Satisfied	**2**	**3**	**4 =Average**	**5**	**6**	**7 = Extremely**

Thanks very much for participating!

NOTE: Questionnaires for Sessions 3 - 5 are identical to Session 2 (above).

Pilot Study Survey

- TDG FINAL -

Questionnaire

Please fill in the following questionnaire. Answer all questions as objectively as you can.

All information will be held in confidence.

If you need to expand any answer please use the reverse side of your paper sheet.

1) Which of the following items/drills did you exercise at least once during the TDG sessions? (Circle all that apply from the list below.)

#	**Knowledge and skills:**
1.	Familiarity with a five paragraph order
2.	Employ Machine guns in support of Offensive Operations
3.	Employ Machine guns in support of Defensive Operations
4.	Infantry Offensive Operations in Field
5.	Infantry Defensive Operations in Field
6.	Tactical Movement On Objective
7.	Fire and Maneuver
8.	Infantry Attack in Urban Terrain
9.	Infantry Defense in Urban Terrain
10.	Issue an Order
11.	Conduct Tactical Movement in the Offense

2) Of the actions that you chose in the previous question (Question 1), with which did you have the most difficulty?
(circle three)

#	**Knowledge and skills:**
1.	Familiarity with a five paragraph order
2.	Employ Machine guns in support of Offensive Operations
3.	Employ Machine guns in support of Defensive Operations
4.	Infantry Offensive Operations in Field
5.	Infantry Defensive Operations in Field
6.	Tactical Movement On Objective

#	Knowledge and skills:
7.	Fire and Maneuver
8.	Infantry Attack in Urban Terrain
9.	Infantry Defense in Urban Terrain
10.	Issue an Order
11.	Conduct Tactical Movement in the Offense

3) Of the actions that you chose in the Question 1, which do you feel you <u>improved upon most</u> during the TDG sessions? (circle three)

#	Knowledge and skills:
1.	Familiarity with a five paragraph order
2.	Employ Machine guns in support of Offensive Operations
3.	Employ Machine guns in support of Defensive Operations
4.	Infantry Offensive Operations in Field
5.	Infantry Defensive Operations in Field
6.	Tactical Movement On Objective
7.	Fire and Maneuver
8.	Infantry Attack in Urban Terrain
9.	Infantry Defense in Urban Terrain
10.	Issue an Order
11.	Conduct Tactical Movement in the Offense

4) When you think about your own knowledge of infantry tactics, techniques, and procedures, how would you rank them? (please circle NA or one number between 1 and 7 in each line)

#	Knowledge and skills:	☐ Your current level ☐ Poor Excellent							
1.	Familiarity with a five paragraph order	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
2.	Employ Machine guns in support of Offensive Operations	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
3.	Employ Machine guns in support of Defensive Operations	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
4.	Infantry Offensive Operations in Field	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
5.	Infantry Defensive Operations in Field	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
6.	Tactical Movement On Objective	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
7.	Fire and Maneuver	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**

#	Knowledge and skills:		☐ Your current level ☐ Poor Excellent						
8.	Infantry Attack in Urban Terrain	NA	1	2	3	4	5	6	7
9.	Infantry Defense in Urban Terrain	NA	1	2	3	4	5	6	7
10.	Issue an Order	NA	1	2	3	4	5	6	7
11.	Conduct Tactical Movement in the Offense	NA	1	2	3	4	5	6	7

5) When you think about your own knowledge of infantry tactics, techniques, and procedures, how much did you improve in each? (please circle NA or one number between 1 and 7 in each line)

#	Knowledge and skills:		☐ They Improved Improve greatly	Your improvement did at					☐ not all
1.	Familiarity with a five paragraph order	NA	1	2	3	4	5	6	7
2.	Employ Machine guns in support of Offensive Operations	NA	1	2	3	4	5	6	7
3.	Employ Machine guns in support of Defensive Operations	NA	1	2	3	4	5	6	7
4.	Infantry Offensive Operations in Field	NA	1	2	3	4	5	6	7
5.	Infantry Defensive Operations in Field	NA	1	2	3	4	5	6	7
6.	Tactical Movement On Objective	NA	1	2	3	4	5	6	7
7.	Fire and Maneuver	NA	1	2	3	4	5	6	7
8.	Infantry Attack in Urban Terrain	NA	1	2	3	4	5	6	7
9.	Infantry Defense in Urban Terrain	NA	1	2	3	4	5	6	7
10.	Issue an Order	NA	1	2	3	4	5	6	7
11.	Conduct Tactical Movement in the Offense	NA	1	2	3	4	5	6	7

4) Rate the TDG experience on its ability to provide you with a good <u>mental picture</u> of the battle space:

1 = poor	**2**	**3**	**4** = average	**5**	**6**	**7** = excellent

5) Rate the following statements (circle one number for each statement):

1.	"During the TDG sessions, I felt like I was taking part in training."		**1** = strongly disagree	**2**	**3**	**4** = neutral	**5**	**6**	**7** = strongly agree
2.	"During the TDG sessions, I felt like my actions/my plan had no consequences to the plans of the group."		**1** = strongly disagree	**2**	**3**	**4** = neutral	**5**	**6**	**7** = strongly agree
3.	"During the TDG sessions, I felt like I was part of the group working together."		**1** = strongly disagree	**2**	**3**	**4** = neutral	**5**	**6**	**7** = strongly agree

4.	"During the TDG sessions, I felt like I was playing a game."		**1** = strongly disagree	**2**	**3**	**4** = neutral	**5**	**6**	**7** = strongly agree
5.	"During the TDG sessions, I felt isolated from the others."		**1** = strongly disagree	**2**	**3**	**4** = neutral	**5**	**6**	**7** = strongly agree

6) In your opinion what was the overall quality of training in the TDG? (circle one)

1 = not satisfactory	**2**	**3**	**4** = average	**5**	**6**	**7** = excellent

7) Throughout all the TDG sessions, do you believe that you made good tactical decisions? (circle one number)

1 = poor	**2**	**3**	**4** = satisfactorily	**5**	**6**	**7** = excellent

8) How well did the TDG sessions meet your expectations regarding training value?

1 = not satisfactorily	**2**	**3**	**4** = satisfactorily	**5**	**6**	**7** = exceptionally well

9) When you think about your future training needs, to what extent would you like it to be supplemented with TDGs?

1 = not satisfactorily	**2**	**3**	**4** = satisfactorily	**5**	**6**	**7** = exceptionally well

10) When you think about your future training needs, to what extent would you like it to be supplemented with computer based simulation of a TDG?

1 = not satisfactorily	**2**	**3**	**4** = satisfactorily	**5**	**6**	**7** = exceptionally well

Thank you very much for participating in the study.

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APPENDIX I - TDS SURVEY (EXPERIMENT 2)

Pilot Survey

- TDS Session 1 -

Pre-questionnaire

Please fill in the following questionnaire. Answer all questions as objectively as you can. All information will be held confidential.

If you need to expand any answer please use the reverse side of your paper sheet.

---

1) Were you required to use computer-based simulations as part of your training in the past? **NO** / **YES** (circle one)

   a) **NO.**

   b) If **YES**: What type simulations have you used and what skills were they used to train?

      i) Tactical Level (Marksmanship trainer, ship driving simulator, Language Trainer, etc.)

         (1) Description:

         _____

         _____

         _____

         _____

         (2) Estimate total number of hours you used it: _____

         (3) To gain competency, this amount of time spent was: (Circle one)

1 = Not Satisfactory	2	3	4 =Average	5	6	7 = Excellent

      ii) Operational Level (OneSAF, JSAF, JCATS, Common Operational Picture of the Battlespace, etc.)

         Description:

         _____

         _____

         _____

         Estimate total number of hours you used it: _____

         (1) To gain competency, this amount of time spent was: (Circle one)

1 = Not Satisfactory	2	3	4 =Average	5	6	7 = Excellent

2) Do you have experience playing commercial video games? **NO** / **YES** (circle one)

   a) **NO.**

b) If **YES**, What kind of video games do you play? (please answer all that apply to you; circle day, week, month or year in each line)

i) First person shooter. (Stand Alone or Online) Approximately _____ hours per **day** / **week** / **month** / **year**

ii) Flight Simulation. (Stand Alone or Online) Approximately _____ hours per **day** / **week** / **month** / **year**

iii) Racing. (Stand Alone or Online) Approximately _____ hours per **day** / **week** / **month** / **year**

iv) Sports (Football, etc.) (Stand Alone or Online) Approximately _____ hours per **day** / **week** / **month** / **year**

v) Puzzle, Card, Board (Stand Alone or Online) Approximately _____ hours per **day** / **week** / **month** / **year**

vi) Strategy (Stand Alone or Online) Approximately _____ hours per **day** / **week** / **month** / **year**

vii) Adventure, Fantasy (Stand Alone or Online) Approximately _____ hours per **day** / **week** / **month** / **year**

viii) Arcade (Stand Alone or Online) Approximately _____ hours per **day** / **week** / **month** / **year**

ix) Other (Stand Alone or Online) Approximately _____ hours per **day** / **week** / **month** / **year**

3) Do you own a personal computer? **NO** / **YES** (circle one)

a) **NO.**

b) If **YES**, how often do you use it? Approximately _____ hours per **day** / **week** / **month** / **year**

4) What hand do you use to operate a computer mouse? **LEFT** / **RIGHT** / **I am good with either** (circle one)

5) How often do you use the following other computer applications? (please answer all that apply to you; circle day, week, month, or year in each line)

i) E-mail: Approximately _____ hours per **day** / **week** / **month** / **year**

ii) Browse Web: Approximately _____ hours per **day** / **week** / **month** / **year**

iii) IMovie: Approximately _____ hours per **day** / **week** / **month** / **year**

iv) ITunes: Approximately _____ hours per **day** / **week** / **month** / **year**

v) Excel: Approximately _____ hours per **day** / **week** / **month** / **year**

vi) Word: Approximately _____ hours per **day** / **week** / **month** / **year**

vii) Power point: Approximately _____ hours per **day** / **week** / **month** / **year**

6) When you think about your own knowledge of infantry tactics, techniques, and procedures, how would you rank them? (please circle NA or one number between 1 and 7 in each line)

#	**Knowledge and skills:**		**Your current level** poor Excellent						
1.	Familiarity with a five paragraph order	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
2.	Employ Machine guns in support of Offensive Operations	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**

3.	Employ Machine guns in support of Defensive Operations	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
4.	Infantry Offensive Operations in Field	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
5.	Infantry Defensive Operations in Field	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
6.	Tactical Movement On Objective	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
7.	Fire and Maneuver	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
8.	Infantry Attack in Urban Terrain	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
9.	Infantry Defense in Urban Terrain	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
10.	Issue an Order	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
11.	Conduct Tactical Movement in the Offense	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**

1) Subject# = (your code name) : _____

2) Date: _____ Time: _____

3) Year of birth: _____

4) Country of Citizenship: _____

5) Service component: (Circle one) :

Army	Navy	Air Force	Marine Corps	Coast Guard	Civilian

6) Briefly describe your Primary MOS, (Example: Infantry, Surface Warfare, communications, etc.):

_____

7) NPS Curriculum: _____

8) Your Rank: _____

9) Time in Service: _____ years _____ months

Thank you very much for participating in the study.

Pilot Study Survey

- TDS Session 2 -

Platoon Leader Questionnaire

Please fill in the following questionnaire. Answer all questions as objectively as you can.

All information will be held confidential.

If you need to expand any answer please use the reverse side of your paper sheet.

Participant # = (Your code name) : _____

Date: _____ Time: _____

1) What training group were you in: (Circle One)

a. Offense

b. Defense

2) For each person (including yourself) give a score between 0 and 100 which estimates the degree to which that person was the 'leader' in the last training session. (The four scores must add to 100).

(For example, if no clear leader emerged, then each should have a score of 25. If Person X played the major role in this regard, then Person X would have a score of say 80, and the other 2 people, a score of 10 each. A score of 0 means that the corresponding person was in no way a leader, whereas a score of 100 means that the corresponding person was the clear and only leader.)

Person (code name):	Score/100:
Total Score:	**100**

3) Think about a previous time when you *enjoyed* working together in a group. To what extent have you *enjoyed* the group experience just now?

I enjoyed the group experience just now (please check one number between 1 and 7):

1. Not at all		It was nothing like the previous experience of working in a group.
2.		
3.		
4.		
5.		
6.		
7. Very much so.		I enjoyed it just as much as the previous experience of working in a group.

4) Think back now about the session that you have just completed. For example, to what extent in your imagination can you move around that terrain (battlefield) now?

I can think myself back on that terrain/battlefield (please check one number between1 and 7):

1. Not at all		I cannot imagine now at all being on that terrain/battlefield now.
2.		
3.		
4.		

5.		
6.		
7. Very much so.		I can strongly imagine being back on that terrain/battlefield now.

5) In the last session, to what extent did you have the sense of the other three people being <u>together with you</u>*?*

In the last session, I had a sense that the other three people were with me (please check one number between 1 and 7):

1. Not at all		I did not have a sense that the other three people were with me.
2.		
3.		
4.		
5.		
6.		
7. Very much so.		The other three people were very much with me.

6) Who did most of the talking? Give a score to each person between 0 and 100, where the four scores add to 100. (A person would be given a score of near 100 only if they did almost all the talking. They would be given a score of near 0 if they did almost no talking).

The extent to which each person did most of the talking was:

Person (code name):	**Score/100:**
Total Score:	**100**

7) Overall, how cooperative was each of the other three people (please check one value between 1 and 7 for each person).

Person (code name) →				
1. Not at all				S/he was not cooperative at all
2.				
3.				
4.				
5.				
6.				
7. Very much so.				S/he was very cooperative

8) Think back now about past session, what were <u>good</u> tactical decision and procedures done by <u>your</u> team?

_____

_____

_____

_____

_____

_____

9) Think back now about past session, what were bad tactical decision and procedures done by your team?

10) Think back now about past session, what were good tactical decision and procedures done by other team?

11) Think back now about past session, what were bad tactical decision and procedures done by other team?

_____

_____

_____

_____

12) What can you say about your SQUAD LEADERS on the following points, where Poor (1) - Excellent (7). (please circle NA or one number between 1 and 7 in each line)

a) Squad Leader #1, Participant's code name: _____

#	**Knowledge and skills:**		**Your current level** poor Excellent						
1.	Understood Operations Order	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
2.	Identified Enemy Most Probably Course of Action (MPCOA)	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
3.	Created a Scheme of Maneuver (SOM)	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
4.	Considers Adjacent Units	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
5.	Created a Fire Support Plan (FSP)	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
6.	Identified Secondary MPCOA	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
7.	Considered the following in Mission Planning Process:								
7.a	- Mission	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
7.b	- Enemy	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
7.c	- Troops Available	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
7.d	- Terrain	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
7.e	- Time	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
8.	Identified Enemy of Center of Gravity and Attacks It.	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
9.	Adjusted to Enemy Situation	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
10.	Took Charge	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
11.	Maintained Oversight of All Subordinate Units	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
12.	Communicated His Plan/Intent to Subordinates	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
13.	Ensured that Subordinates what they had been told	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
14.	Used deception and creativity to outwit the enemy	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
15.	Deviated from doctrine when necessary	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
16.	Enemy Location	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**

#	Knowledge and skills:		Your current level poor Excellent						
17.	Size of Enemy Element	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
18.	Direction of Enemy Movement	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
19.	Understanding of Battle Space Geometry	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**

b) Squad Leader #2, Participant's code name: _____

#	Knowledge and skills:		Your current level poor Excellent						
1.	Understood Operations Order	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
2.	Identified Enemy Most Probably Course of Action (MPCOA)	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
3.	Created a Scheme of Maneuver (SOM)	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
4.	Considers Adjacent Units	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
5.	Created a Fire Support Plan (FSP)	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
6.	Identified Secondary MPCOA	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
7.	Considered the following in Mission Planning Process:								
7.a	- Mission	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
7.b	- Enemy	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
7.c	- Troops Available	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
7.d	- Terrain	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
7.e	- Time	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
8.	Identified Enemy of Center of Gravity and Attacks It.	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
9.	Adjusted to Enemy Situation	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
10.	Took Charge	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
11.	Maintained Oversight of All Subordinate Units	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
12.	Communicated His Plan/Intent to Subordinates	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
13.	Ensured that Subordinates what they had been told	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
14.	Used deception and creativity to outwit the enemy	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
15.	Deviated from doctrine when necessary	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
16.	Enemy Location	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
17.	Size of Enemy Element	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**

#	Knowledge and skills:		Your current level - poor Excellent						
18.	Direction of Enemy Movement	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
19.	Understanding of Battle Space Geometry	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**

c) Squad Leader #3, Participant's code name: _____

#	Knowledge and skills:		Your current level - poor Excellent						
1.	Understood Operations Order	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
2.	Identified Enemy Most Probably Course of Action (MPCOA)	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
3.	Created a Scheme of Maneuver (SOM)	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
4.	Considers Adjacent Units	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
5.	Created a Fire Support Plan (FSP)	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
6.	Identified Secondary MPCOA	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
7.	Considered the following in Mission Planning Process								
7.a	- Mission	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
7.b	- Enemy	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
7.c	- Troops Available	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
7.d	- Terrain	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
7.e	- Time	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
8.	Identified Enemy of Center of Gravity and Attacks It.	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
9.	Adjusted to Enemy Situation	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
10.	Took Charge	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
11.	Maintained Oversight of All Subordinate Units	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
12.	Communicated His Plan/Intent to Subordinates	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
13.	Ensured that Subordinates what they had been told	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
14.	Used deception and creativity to outwit the enemy	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
15.	Deviated from doctrine when necessary	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
16.	Enemy Location	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
17.	Size of Enemy Element	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
18.	Direction of Enemy Movement	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**

#	Knowledge and skills:		Your current level - poor Excellent						
19.	Understanding of Battle Space Geometry	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**

d) YOURSELF on the following criteria where Poor (1) - Excellent (7). (please circle NA or one number between 1 and 7 in each line)

#	Knowledge and skills:		Your current level - poor Excellent						
1.	Understood Operations Order	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
2.	Identified Enemy Most Probably Course of Action (MPCOA)	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
3.	Created a Scheme of Maneuver (SOM)	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
4.	Considers Adjacent Units	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
5.	Created a Fire Support Plan (FSP)	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
6.	Identified Secondary MPCOA	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
7.	Considered the following in Mission Planning Process:								
7.a	- Mission	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
7.b	- Enemy	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
7.c	- Troops Available	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
7.d	- Terrain	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
7.e	- Time	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
8.	Identified Enemy of Center of Gravity and Attacks It.	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
9.	Adjusted to Enemy Situation	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
10.	Took Charge	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
11.	Maintained Oversight of All Subordinate Units	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
12.	Communicated His Plan/Intent to Subordinates	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
13.	Ensured that Subordinates what they had been told	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
14.	Used deception and creativity to outwit the enemy	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
15.	Deviated from doctrine when necessary	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
16.	Enemy Location	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
17.	Size of Enemy Element	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
18.	Direction of Enemy Movement	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**

#	Knowledge and skills:		Your current level poor Excellent						
19.	Understanding of Battle Space Geometry	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**

13) If you did not have enough time to become familiar with the infantry TTPs of the offense or defense (whichever you participated in), how much more time do you believe you would need?

_____

14) How satisfied were you with your overall performance while using the CCM TDS:

1 = Not Satisfied	**2**	**3**	**4 =Average**	**5**	**6**	**7 = Extremely**

Thanks very much for participating!

NOTE:

Pilot Study Survey

- TDS FINAL -

Please fill in the following questionnaire. Answer all questions as objectively as you can.

All information will be held confidential.

If you need to expand any answer please use the reverse side of your paper sheet.

---

1) Which of the following items/drills did you exercise at least once during the TDS sessions? (Circle all that apply from the list below.)

#	**Knowledge and skills:**
1.	Familiarity with a five paragraph order
2.	Employ Machine guns in support of Offensive Operations
3.	Employ Machine guns in support of Defensive Operations
4.	Infantry Offensive Operations in Field
5.	Infantry Defensive Operations in Field
6.	Tactical Movement On Objective
7.	Fire and Maneuver
8.	Infantry Attack in Urban Terrain
9.	Infantry Defense in Urban Terrain
10.	Issue an Order
11.	Conduct Tactical Movement in the Offense

2) Of the actions that you chose in the previous question (Question 1), with which did you have the <u>most difficulty</u>?
(circle three)

#	**Knowledge and skills:**
1.	Familiarity with a five paragraph order
2.	Employ Machine guns in support of Offensive Operations
3.	Employ Machine guns in support of Defensive Operations
4.	Infantry Offensive Operations in Field
5.	Infantry Defensive Operations in Field
6.	Tactical Movement On Objective

#	Knowledge and skills:
7.	Fire and Maneuver
8.	Infantry Attack in Urban Terrain
9.	Infantry Defense in Urban Terrain
10.	Issue an Order
11.	Conduct Tactical Movement in the Offense

3) Of the actions that you chose in the Question 1, which do you feel you improved upon most during the TDG sessions? (circle three)

#	Knowledge and skills:
1.	Familiarity with a five paragraph order
2.	Employ Machine guns in support of Offensive Operations
3.	Employ Machine guns in support of Defensive Operations
4.	Infantry Offensive Operations in Field
5.	Infantry Defensive Operations in Field
6.	Tactical Movement On Objective
7.	Fire and Maneuver
8.	Infantry Attack in Urban Terrain
9.	Infantry Defense in Urban Terrain
10.	Issue an Order
11.	Conduct Tactical Movement in the Offense

4) When you think about your own knowledge of infantry tactics, techniques, and procedures, how would you rank them? (please circle NA or one number between 1 and 7 in each line)

#	Knowledge and skills:		☐ Poor			Your current level			☐ Excellent
1.	Familiarity with a five paragraph order	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
2.	Employ Machine guns in support of Offensive Operations	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
3.	Employ Machine guns in support of Defensive Operations	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
4.	Infantry Offensive Operations in Field	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
5.	Infantry Defensive Operations in Field	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
6.	Tactical Movement On Objective	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
7.	Fire and Maneuver	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**

#	Knowledge and skills:	☐ Poor Excellent	Your current level						☐
8.	Infantry Attack in Urban Terrain	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
9.	Infantry Defense in Urban Terrain	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
10.	Issue an Order	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
11.	Conduct Tactical Movement in the Offense	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**

5) When you think about your own knowledge of infantry tactics, techniques, and procedures, how much did you improve in each? (please circle NA or one number between 1 and 7 in each line)

#	Knowledge and skills:	☐ They Improved Improve greatly	Your improvement did at						☐ not at all
1	Familiarity with a five paragraph order	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
2	Employ Machine guns in support of Offensive Operations	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
3	Employ Machine guns in support of Defensive Operations	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
4	Infantry Offensive Operations in Field	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
5	Infantry Defensive Operations in Field	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
6	Tactical Movement On Objective	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
7	Fire and Maneuver	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
8	Infantry Attack in Urban Terrain	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
9	Infantry Defense in Urban Terrain	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
1	Issue an Order	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
1	Conduct Tactical Movement in the Offense	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**

6) How would you rank your ability to navigate through the virtual world and use the controls in simulation?

1.	**NAVIGATION/MOVING THROUGH THE TERRAIN:**	1 = **POOR**	2	3	4 = **AVERAGE**	5	6	7 = **EXCELLENT**
2.	**OTHER CONTROLS:**	1 = **POOR**	2	3	4 = **AVERAGE**	5	6	7 = **EXCELLENT**

7) Rate the simulation ability to provide you with good visual and audio cues so that you can identify all threats during the mission:

1.	Visual cues:	**1** = poor	**2**	**3**	**4** = average	**5**	**6**	**7** = excellent
2.	Audio cues:	**1** = poor	**2**	**3**	**4** = average	**5**	**6**	**7** = excellent

8) Rate the following statements (circle one number for each statement):

1.	"During the session with computer simulation, I felt like I was taking part in training."		**1** = strongly disagree	**2**	**3**	**4** = neutral	**5**	**6**	**7** = strongly agree
2.	"During the session with computer simulation, I felt like my actions in virtual world had no consequences to the others and to the virtual world."		**1** = strongly disagree	**2**	**3**	**4** = neutral	**5**	**6**	**7** = strongly agree
3.	"During the session with computer simulation, I felt like I was part of the group working together."		**1** = strongly disagree	**2**	**3**	**4** = neutral	**5**	**6**	**7** = strongly agree
4.	"During the session with computer simulation, I felt like I was playing a game."		**1** = strongly disagree	**2**	**3**	**4** = neutral	**5**	**6**	**7** = strongly agree
5.	"During the session with computer simulation, I felt isolated from the others."		**1** = strongly disagree	**2**	**3**	**4** = neutral	**5**	**6**	**7** = strongly agree

9) In your opinion what was the overall <u>quality</u> of training in computer based training simulation? (circle one)

1 = not satisfactory	**2**	**3**	**4** = average	**5**	**6**	**7** = excellent

10) Throughout all the TDS sessions, please rate the quality of your tactical decisions. (circle one number)

1 = poor	**2**	**3**	**4** = satisfactory	**5**	**6**	**7** = excellent

11) What were your expectations regarding the ability of simulation to train you in the previous set of skills mentioned in Questions 1, 2, and 3?

1 = low	**2**	**3**	**4** = average	**5**	**6**	**7** = high

12) How well did the use of simulation meet your expectations regarding training value?

1 = not satisfactorily	**2**	**3**	**4** = satisfactorily	**5**	**6**	**7** = exceptionally well

13) Circle one number that best reflects your opinion:

	When you think about your future training needs, to what extent would you <u>like</u> it to be supplemented with computer based simulations like CCM?	**1** = not at all	**2**	**3**	**4** = moderately	**5**	**6**	**7** = very much

Thank you very much for participating in the study.

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APPENDIX J - TDG/TDS SCHEDULE (EXPERIMENT 2)

TDG
- APPROXIMATED TBS Design -

****

Phase I - Pre-Training (Individual)

****

SETTING: Classroom/Lab (Watkins 212A & MOCAP Lab)
METHOD OF INSTRUCTION: TDG

00-10 TIME: 10 Minutes - Initial Long Pre-Questionnaire

SCENARIO: 1-1a- Town(a)

10-30 TIME: 20 Minutes - Conduct of the TDG
TIME: Minutes - What is a TDG?
-Planning Sequence
1. Read and Understand Operation Order
2. Estimate Enemy activity
3. Plan your response
4. What-if your plan.
5. Move troops to attack/defense positions
6. Conduct Offensive/Defensive operations
7. Conduct After-Action Review

-Offensive Tactics Training (OPFOR)
1. Support by Fire Positions
2. Distribution of Forces
3. Exposure (use terrain to mask movement and positions)
4. Use Smoke to cover movement.
5. Create and Use a Fire Support Plan
6. Don't give conflicting orders (ex. "Dig in" and "Move Fast")
7. Maneuver Warfare
   a) Fire and Maneuver [SAM-K (Suppress, Assess, Maneuver, Kill)] (I cover you, you cover me during movements).
   b) De-escalation of the Fire support upon approach
      i. Artillery
      ii. BN mortars
      iii. CO mortars
      iv. Medium machine guns
      v. Squad automatic weapons
      vi. M-16
      vii. Grenades
8. Tactical movement (moving fast or moving covert)
9. Long/Unsupported movements are bad
10. Use of the reserve

- Defensive Tactics Training (MARINES)
1. Dig in when possible
2. Envision Enemy's attack based on the OpOrd
3. Select the ground where you can stop the enemy attack
4. Select troop battle positions based on your expectation
5. Ensure interlocking Sectors of Fire on this ground
6. Envision the enemy's reaction to this initial contact
7. Have a plan to counter the enemy's reaction to initial contact
8. Give key weapons primary and secondary positions of expected enemy action/reaction
9. Use Rifle Squads to cover the flanks of your key weapons
10. Use covered movements between primary and supplemental positions (some units may not move)
11. Control of Fires
12. Be flexible. (i.e., Don't stick to your plan if it is not working.)
13. Use primary, alternate, supplemental positions, a reserve.
NOTE: Platoons and squads are not large enough to designate a static reserve. One unit should be designated to break contact and act as the reserve if needed.
14. Establish a withdrawal plan if you need to evacuate the area. (route, sequence,

30-40 Conducting a 10 minute TDG introduction
00-02 Division Of The Teams Into 2 Groups
02-04 Passing out The Material For TDG
04-10 Explanation of what Each Person Is Supposed To
40-45 TIME: 5 Minutes - After Action
45-50 TIME: 5 Minutes - Post Questionnaire

****

Phase II - Tactics Training - Defense
(Team)

****

SCENARIO: 3-1a - Town (b)

00-05 TIME: 5 Minutes Instructor Introduction with Reading of OpOrder
05-15 TIME: 10 Minutes
TIME: 5 Minutes Group Discussion
TIME: 5 Minutes Individual Student Planning
-Mission Enemy Terrain Troops - Time (METT-T)
-conduct map recon
-estimate of situation
-sketch tactical plan on map
15-25 TIME: 10 Minutes Internal Team discussion on WHY each individual chose his COA
25-49 TIME: 24 Minutes Team Leader Picked and Briefs Overall Plan (Instructors may pause for critical discussion points)
TIME 12: Team 1 Briefs
Time 12: Team 2 Briefs
49-54 TIME: 5 Minutes - Individuals Write down the good/bad points of your team's and the other team's plan
54-59 TIME: 5 Minutes - Post-Questionnaire with After Action Section
(Subject Matter Experts (SMEs) Provide Evaluation on Tactical Decision-Making and
Platoon Level Leadership)
59-65 TIME: 6 Minutes - Phase II After-Action Review

Source of Time Information: J.D. DeForest combined with DVD of Experiment with Dr. Sadagic

****

Phase III - Tactics Training - Offense
(Team Internal Role Shift)

****

SCENARIO: 3-1a- Town (b)

00-05 TIME: 5 Minutes Instructor Introduction with Reading of OpOrder
05-15 TIME: 10 Minutes
TIME: 5 Minutes Group Discussion
TIME: 5 Minutes Individual Student Planning
-Mission Enemy Terrain Troops - Time (METT-T)
-conduct map recon
-estimate of situation
-sketch tactical plan on map
15-25 TIME: 10 Minutes Internal Team discussion on WHY each individual chose his COA
25-49 TIME: 24 Minutes Team Leader Picked and Briefs Overall Plan (Instructors may pause for critical discussion points)
TIME 12: Team 1 Briefs
Time 12: Team 2 Briefs
49-54 TIME: 5 Minutes - Individuals Write down the good/bad points of your team's and the other team's plan
54-59 TIME: 5 Minutes - Post-Questionnaire with After Action Section
(Subject Matter Experts (SMEs) Provide Evaluation on Tactical Decision-Making and
Platoon Level Leadership)
59-65 TIME: 6 Minutes - Phase II After-Action Review

Source of Time Information: J.D. DeForest combined with DVD of Experiment with Dr. Sadagic

****

Phase IV - Tactics Training - Defense
(Team Internal Role Shift)

****

SCENARIO: 2-1a - Airfield

00-05 TIME: 5 Minutes Instructor Introduction with Reading of OpOrder

05-15 TIME: 10 Minutes
TIME: 5 Minutes Group Discussion
TIME: 5 Minutes Individual Student Planning
-Mission Enemy Terrain Troops - Time (METT-T)
-conduct map recon
-estimate of situation
-sketch tactical plan on map
15-25 TIME: 10 Minutes Internal Team discussion on WHY each individual chose his COA
25-49 TIME: 24 Minutes Team Leader Picked and Briefs Overall Plan (Instructors may pause for critical discussion points)
TIME 12: Team 1 Briefs
Time 12: Team 2 Briefs
49-54 TIME: 5 Minutes - Individuals Write down the good/bad points of your team's and the other team's plan
54-59 TIME: 5 Minutes - Post-Questionnaire with After Action Section
(Subject Matter Experts (SMEs) Provide Evaluation on Tactical Decision-Making and
Platoon Level Leadership)
59-65 TIME: 6 Minutes - Phase II After-Action Review

Source of Time Information: J.D. DeForest combined with DVD of Experiment with Dr. Sadagic
****

Phase V - Tactics Training/Force on Force
(Team Internal Role Shift)

****

SCENARIO: 6-1a - Farm

00-05 TIME: 5 Minutes Instructor Introduction with Reading of OpOrder
05-15 TIME: 10 Minutes
TIME: 5 Minutes Group Discussion
TIME: 5 Minutes Individual Student Planning
-Mission Enemy Terrain Troops - Time (METT-T)
-conduct map recon
-estimate of situation
-sketch tactical plan on map
15-25 TIME: 10 Minutes Internal Team discussion on WHY each individual chose his COA
25-49 TIME: 24 Minutes Team Leader Picked and Briefs Overall Plan (Instructors may pause for critical discussion points)
TIME 12: Team 1 Briefs
Time 12: Team 2 Briefs
49-54 TIME: 5 Minutes - Individuals Write down the good/bad points of your team's and the other team's plan
54-59 TIME: 5 Minutes - Post-Questionnaire with After Action Section
(Subject Matter Experts (SMEs) Provide Evaluation on Tactical Decision-Making and
Platoon Level Leadership)
59-65 TIME: 6 Minutes - Phase II After-Action Review

Source of Time Information: J.D. DeForest combined with DVD of Experiment with Dr. Sadagic
****

TDS
- Pilot Study Design -

****

Phase I - Pre-Training
(Individual Intro to Tactics)

****

SETTING: Classroom/Lab (Watkins 212A)
METHOD OF INSTRUCTION: Lecture with PowerPoint Presentation. CCM.

00-10 TIME: 10 Minutes - Initial Long Pre-Questionnaire

10-15 TIME: 5 Minutes - Instruction via Lecture & PPT.

-Show Opening CCM Screen
-Describe the three entry points (Command, Editor, Boot Camp)
-Go into Command
-Operation of the simulation
1. Left Click = Highlight Unit, Right Click = Issue Orders
2. Ambush 30m/Defend 200m
3. Firing/Range indicator
4. # on Buildings = # indicates Levels
5. Navigation - arrows/map
6. To get Elevation Data - Right Click on terrain
7. Space Bar - Leadership Circle

15-35 TIME: 20 Minutes (10 Minutes OPFOR/10 Minutes MARINES)

-Planning Sequence
1. Read and Understand Operation Order
2. Estimate Enemy activity
3. Plan your response
4. What-if your plan.
5. Move troops to attack/defense positions
6. Conduct Offensive/Defensive operations
7. Conduct After-Action Review

-Offensive Tactics Training (OPFOR)
1. Support by Fire Positions
2. Distribution of Forces
3. Exposure (use terrain to mask movement and positions)
4. Use Smoke to cover movement.
5. Create and Use a Fire Support Plan
6. Don't give conflicting orders (ex. "Dig in" and "Move Fast")
7. Maneuver Warfare
a) Fire and Maneuver [SAM-K (Suppress, Assess, Maneuver, Kill)] (I cover you, you cover me during movements).
b) De-escalation of the Fire support upon approach
i. Artillery
ii. BN mortars
iii. CO mortars
iv. Medium machine guns
v. Squad automatic weapons
vi. M-16
vii. Grenades
8. Tactical movement (moving fast or moving covert)
9. Long/Unsupported movements are bad
10. Use of the reserve

- Defensive Tactics Training (MARINES)
1. Dig in when possible
2. Envision Enemy's attack based on the OpOrd
3. Select the ground where you can stop the enemy attack
4. Select troop battle positions based on your expectation
5. Ensure interlocking Sectors of Fire on this ground
6. Envision the enemy's reaction to this initial contact
7. Have a plan to counter the enemy's reaction to initial contact

8. Give key weapons primary and secondary positions of expected enemy action/reaction
9. Use Rifle Squads to cover the flanks of your key weapons
10. Use covered movements between primary and supplemental positions (some units may not move)
11. Control of Fires
12. Be flexible. (i.e., Don't stick to your plan if it is not working.)
13. Use primary, alternate, supplemental positions, a reserve.
NOTE: Platoons and squads are not large enough to designate a static reserve. One unit should be designated to break contact and act as the reserve if needed.
14. Establish a withdrawal plan if you need to evacuate the area. (route, sequence,

SCENARIO: 1-1a - Town (a) as OPFOR for Offense/Marines for Defense
(Researchers Available for Questions/Help)

Individual Hands-On Session
35-37 TIME: 2 Minutes - Placement of Troops
37-47 TIME: 10 Minutes - Offensive Training
47-57 TIME: 10 Minutes - Defensive Training
57-62 TIME: 5 Minutes - After Action
62-67 TIME: 5 Minutes - Post Questionnaire

****

Phase II - Team Tactics
(Team Offense or Team Defense)

****

SETTING: Classroom/Lab (Watkins 212A & MOCAP Lab)
METHOD OF INSTRUCTION: Lecture with CCM.

00-10 TIME: 10 Minutes - Tactics Review from Phase I
- REVIEW Offensive Tactics Training (5 Minutes)
- REVIEW Defensive Tactics Training (5 Minutes)

SCENARIO: 3-1b - Town (b)
(OPFOR for Offense/Marines for Defense (Researchers Available for Questions/Help))

10-12 TIME: 2 Minutes - Issue Operations Order
12-15 TIME: 3 Minute - Planning
15-17 TIME: 2 Minutes - Troops Placement
17-39 TIME: 22 Minutes - Team CCM Hands-On
32-34 TIME: 2 Minutes - GRADE Evaluation of Situational Awareness
39-44 TIME: 5 Minutes - Post-Questionnaire with After Action Section
(Subject Matter Experts (SMEs) Provide Evaluation on Tactical Decision-Making and Platoon Level Leadership)
44-49 TIME: 5 Minutes - Phase II After-Action Review

****

Phase III - Team Tactics
(Team Offense or Team Defense…Switch from Phase II)

****

SETTING: Classroom/Lab (Watkins 212A & MOCAP Lab)
METHOD OF INSTRUCTION: CCM.

SCENARIO: 3-1b - Town (b)
(OPFOR for Offense/Marines)

05-07 TIME: 2 Minutes - Issue Operations Order
07-10 TIME: 3 Minute - Planning
10-12 TIME: 2 Minutes - Troops Placement
12-56 TIME: 44 Minutes - Team CCM Hands-On
32-34 TIME: 2 Minutes -GRADE 1
44-46 TIME: 2 Minutes -GRADE 2
56-61 TIME: 5 Minutes - Post-Questionnaire with After Action Section
(Subject Matter Experts (SMEs) Provide Evaluation on Tactical Decision-Making and Platoon Level Leadership)
61-66 TIME: 5 Minutes - Phase III After-Action Review

****

Phase IV - Team Tactics
(Team Offense or Team Defense…Switch from Phase III)

****

SETTING: Classroom/Lab (Watkins 212A & MOCAP Lab)
METHOD OF INSTRUCTION: CCM.

SCENARIO: 2-1b - Airfield
(OPFOR for Offense/Marines for Defense (Researchers Available for Questions/Help)

05-07 TIME: 2 Minutes - Issue Operations Order
07-10 TIME: 3 Minute - Planning
10-12 TIME: 2 Minutes - Troops Placement
12-56 TIME: 44 Minutes - Team CCM Hands-On
    32-34 TIME: 2 Minutes - GRADE 1
    44-46 TIME: 2 Minutes - GRADE 2
56-61 TIME: 5 Minutes - Post-Questionnaire with After Action Section
    (Subject Matter Experts (SMEs) Provide Evaluation on Tactical Decision-Making and Platoon Level Leadership)
61-66 TIME: 5 Minutes - Phase IV After-Action Review

****

Phase V - Team Tactics
(Team Offense or Team Defense…Switch from Phase IV)

****

SETTING: Classroom/Lab (Watkins 212A & MOCAP Lab)
METHOD OF INSTRUCTION: CCM.

SCENARIO: 6-1b - Farm
(OPFOR for Offense/Marines for Defense (Researchers Available for Questions/Help)

05-07 TIME: 2 Minutes - Issue Operations Order
07-10 TIME: 3 Minute - Planning
10-12 TIME: 2 Minutes - Troops Placement
12-56 TIME: 44 Minutes - Team CCM Hands-On
    32-34 TIME: 2 Minutes - GRADE 1
    44-46 TIME: 2 Minutes - GRADE 2
56-61 TIME: 5 Minutes - Post-Questionnaire with After Action Section
    (Subject Matter Experts (SMEs) Provide Evaluation on Tactical Decision-Making and Platoon Level Leadership)
61-66 TIME: 5 Minutes - Phase V After-Action Review

****

APPENDIX K - CCM OPERATION ORDERS (EXPERIMENT 2)

SESSION 1

Module 1 Fight 1-1a OpOrder (Marines - DEFENSE)

I. Situation: Enemy patrols, mostly squad size, have become increasingly bolder as we have withdrawn (South). I think we can expect tentative contact here in the village this morning. Battalion withdraws (South) and repositions in order to turn over this sector to allied forces.

II. Mission: "A" Company guards the Battalion rear in order to prevent Enemy interference with our withdrawal.

III. Execution: (1) Platoon is detached to Battalion. (1) platoon guards the town while (1) Platoon moves (South) to establish next rear guard Position.

Fire Support: No Close Air Support. No Artillery. No Mortars.

Tasks:

1st Platoon: Main Effort. Guard the Company rear in order to prevent Enemy interference with our withdrawal.

2nd Platoon: Detached.

3rd Platoon: Move (South) and establish next rear guard Position in order to permit 1st Platoon to withdraw.

Mortars: Priority of Fires to 3rd Platoon.

IV. Admin and Logistics: Standard Operating Procedure.

V. Command and Signal: Standard Operating Procedure.

SESSION 1

Module 1 Fight 1-1a OpOrder (Opposing Force (OPFOR) - OFFENSE)

I. Situation: An Enemy squad with a machine gun holds the village. I think they missed their withdrawal and are now planning on fighting to the end. Battalion secures a Defensive Position 6k (East) in order to destroy an anticipated Enemy Counter-Attack.

II. Mission: "E" Company clears the town in order to remove Enemy forces.

III. Execution: While (1) Main Effort Platoon clears (South) through the village, (1) Platoon screens (East) of the village. (1) Platoon Reserve.

Fire Support: No Close Air support. No Artillery.

Tasks:

1st Platoon: Main Effort. Clear (South) through the village IOT remove Enemy forces.

2nd Platoon: Screen (East) of the village in order to identify and report Enemy activities.

3rd Platoon: Reserve. Follow in Trace of 1st Platoon. Be prepared to Cover Main Effort.

Sniper Team: You are in Direct Support of the Main Effort.

IV. Admin and Logistics: Standard Operating Procedure.

V. Command and Signal: Standard Operating Procedure.

SESSION 2 & 3

Module 5 Fight 5-1a OpOrder (OPFOR)

I. Situation: Enemy patrols, mostly squad size, have become increasingly bolder as we have withdrawn (West). I think we can expect tentative contact here in the village this morning. Battalion withdraws (West) and repositions in order to conduct a counter attack.

II. Mission "E" Company guards the Battalion rear in order to prevent Enemy interference with our withdrawal.

III. Execution (1) Platoon is detached to Battalion. (1) Platoon guards the town while (1) Platoon moves (West) to establish next rear guard Position.

FS: No Close Air Support. No artillery. No Mortars.

Tasks:
1st Platoon: Main Effort. Guard the Company rear in order to prevent Enemy interference with our withdrawal.

2nd Platoon: Detached.

3rd Platoon: Move (West) and establish next rear guard Position in order to permit 1st Platoon to Withdraw.

Mortars: Priority of Fire to 3rd Platoon.

IV. Admin and Logistics: Standard Operating Procedure.

V. Command and Signal: Standard Operating Procedure.

SESSION 2 & 3

Module 5 Fight 5-1a OpOrder (MARINES-OFFENSE)

I. Situation: An Enemy Squad with a Machine Gun holds the bank building, the last organized resistance in the village. I think they missed their withdrawal and are now planning on fighting to the end. Battalion secures a defensive position 6 kilometers (West) in order to stop an anticipated Enemy counter attack.

II. Mission: "A" Company clears the town in order to free the road from Enemy control.

III. Execution: While (1) Platoon clears (South), the Main effort Platoon clears (West) to the Bank. Reserve Platoon then clears the rest of town.

FS: No Close Air Support. No Artillery. Mortars to 2nd Platoon.

Tasks:
1st Platoon: Main Effort. Clear (West) to the bank in order to free the road from Enemy control.

2nd Platoon: Clear (South) across the river in order to free the road from Enemy control.

3rd Platoon: RESERVE. Be Prepared To clear the town in order to free the road from Enemy control.

Mortars: Priority of Fire is to 2nd Plat.

IV. Admin and Logistics: Standard Operating Procedure.

V. Command and Signal: Standard Operating Procedure.

SESSION 4

Module 2 Fight 2-1a OpOrder (Marines - OFFENSE)

I. Situation: Scattered Enemy units, maybe (20) soldiers, remain in the vicinity of the airfield. They may have a Heavy Machine Gun, mortar, or Anti-Aircraft missile that could threaten our helicopters. The remainder of the battalion will fly into the airfield once the Anti-Aircraft threat is reduced in order to stage for follow-on operations. I think the Enemy will avoid contact with us and wait to target the helicopters.

II. Mission: "A" Company clears the area around the airfield in order to prevent Enemy interference with air operations.

III. Execution: While (1) Platoon blocks the (North) access road, (2) Platoons clear both sides of the airfield from (North) to (South).

FS: Rotary Wing Close Air Support On-Call. No Artillery. Mortars with 1st Platoon.

Tasks:
1st Platoon: Main Effort. Clear (West) side of airfield in order to prevent Enemy interference with air operations.

2nd Platoon: Clear (East) side of airfield in order to prevent Enemy interference with air operations.

3rd Platoon: Block (North) approach to airfield in order to prevent Enemy Counter-Attack.

Mortars: Priority of Fire to the Main Effort.

IV. Admin and Logistics: Standard Operating Procedure.

V. Command and Signal: Standard Operating Procedure.

SESSION 4

Module 2 Fight 2-1a OpOrder (Opposing Force (OpFor) - DEFENSE)

I. Situation: An Enemy unit, possibly Company sized is located 10 kilometers to the (North West). They may be intending to use the airfield as a staging area for FOF. The remainder of our Battalion is located 15 kilometers to the (East). I think the Enemy will attempt to seize the airfield within the next (2) hours.

II. Mission: "E" Company Controls the airfield in order to prevent Enemy use.

III. Execution: (1) Platoon Clears (West) side of airfield, (1) Platoon Clears (East) side of airfield. (1) Platoon detached to Battalion.

FS: No Close Air Support. No Artillery. Mortars to Main Effort.

Tasks:
1st Platoon: Main Effort. Clear the (West) side of airfield in order to prevent Enemy use.

2nd Platoon: Clear (East) side of airfield in order to prevent Enemy use.

3rd Platoon: Detached Mortars: Priority of Fire to Main Effort.

IV. Admin and Logistics: Standard Operating Procedure.

V. Command and Signal: Standard Operating Procedure.

SESSION 5

Module 6 Fight 6-1a OpOrder (Marines - OFFENSE)

I. Situation: An Enemy patrol has cut the road at the village, stranding a convoy farther (East). Enemy is believed to number (12) to (15) soldiers and have shoulder-fired missiles. The convoy reports additional Enemy movement in the hills to their (East), trapping them in place. I think the Enemy will focus on the road traffic and less on the overland approaches to the village. This main road links our Battalion, 4 kilometers (West), with 2nd Battalion, 17 kilometers (East). Tomorrow, Battalion moves (North) and secures river line in order to prevent Enemy crossings.

II. Mission: "A" Company destroys the Enemy in the village in order to clear the road for convoy operations.

III. Execution: (2) Platoons envelop the village from the (North). Heavy Machine Gun Squad provides SBF vicinity of the road.

FS: Rotary Wing Close Air Support On call. Artillery On call. Mortars with Main Effort.

Tasks:
1st Platoon: Main Effort. Destroy the Enemy in the village in order to clear the road for convoy operations.

2nd Platoon: RESERVE. Follow in trace of 1st Platoon be prepared to continue Attack.

3rd Platoon: Detached.

Heavy Machine Gun Squad: Direct Support to Main Effort.

Mortars: Priority of Fire to Main Effort.

IV. Admin and Logistics: Standard Operating Procedure.

V. Command and Signal: Standard Operating Procedure.

SESSION 5

Module 6 Fight 6-1a OpOrder (Opposing Force (OpFor) - DEFENSE)

I. Situation: Enemy Company has been sighted (West) of the town. I think the Enemy will attack us with a reinforced platoon here in town in order to gain control of this road network. Battalion secures this (East)-(West) Main Service Route in order to prevent Enemy interference with resupply convoys.

II. Mission "E" Company secures the town in order to protect the Main Service Route from Enemy interference.

III. Execution (1) Platoon secures the town. (1) Platoon secures the (South) road. (1) Platoon is detached.

FS: No Close Air Support. No artillery. No Mortars.

Tasks:
1st Platoon: Main Effort. Secure the town in order to protect the Main Service Route.

2nd Platoon: Detached.

3rd Platoon: Move (South) and secure road sector in order to protect Main Service Route.

Mortars: Priority of Fire is to 3rd Platoon.

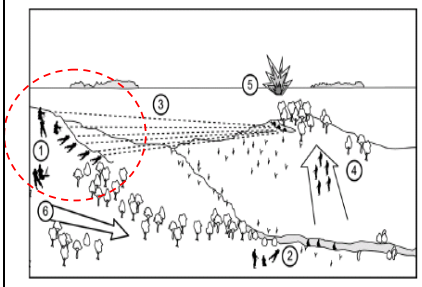
IV. Admin and Logistics: Standard Operating Procedure.

V. Command and Signal: Standard Operating Procedure.

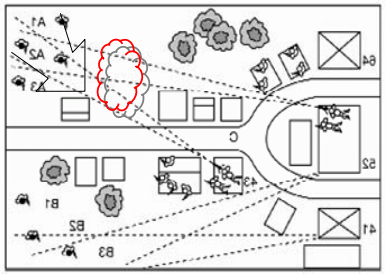
APPENDIX L - TACTICS MEMORY SHEET (EXPERIMENT 2)

Offensive Tactics

Support By Fire Position

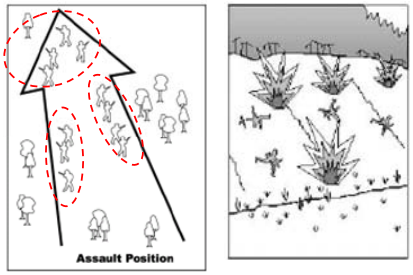


Use of Smoke

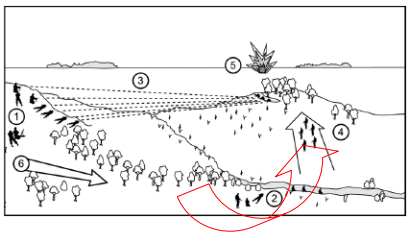


Offensive Tactics

Distribution of Forces

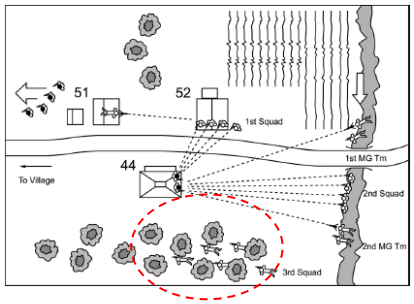


Maneuver

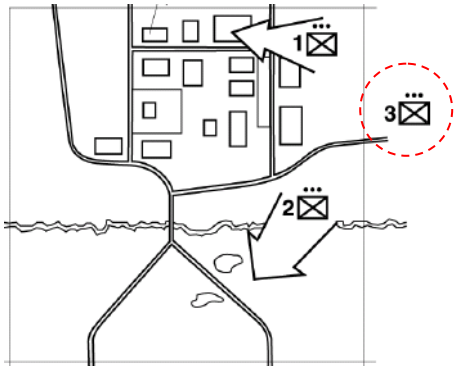


Offensive Tactics

Use Terrain to Mask Mvmt

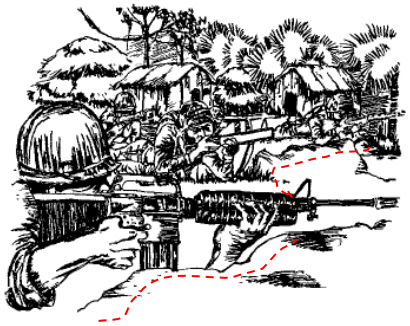


Use of the Reserve

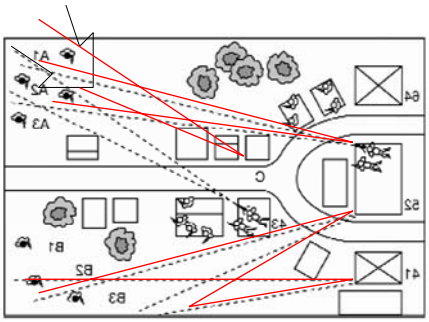


Defensive Tactics

Dig In When Possible

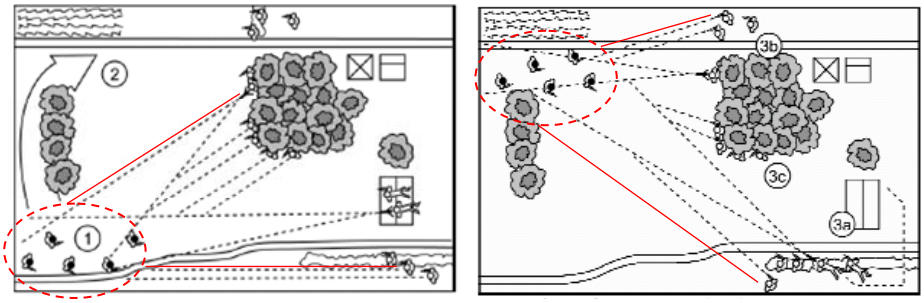


Ensure Interlocking Sectors of Fire



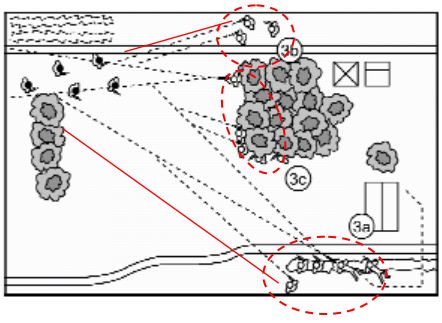
Defensive Tactics

Select Killing Ground

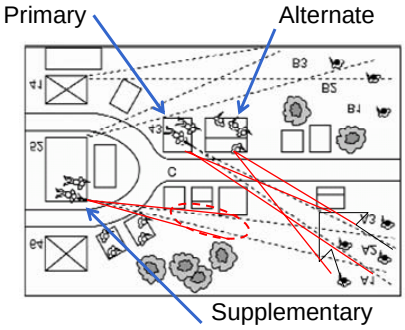


Defensive Tactics

Select Battle Position Based on Expectation of Enemy Advance



Use Primary, Alternate, Supplementary Positions



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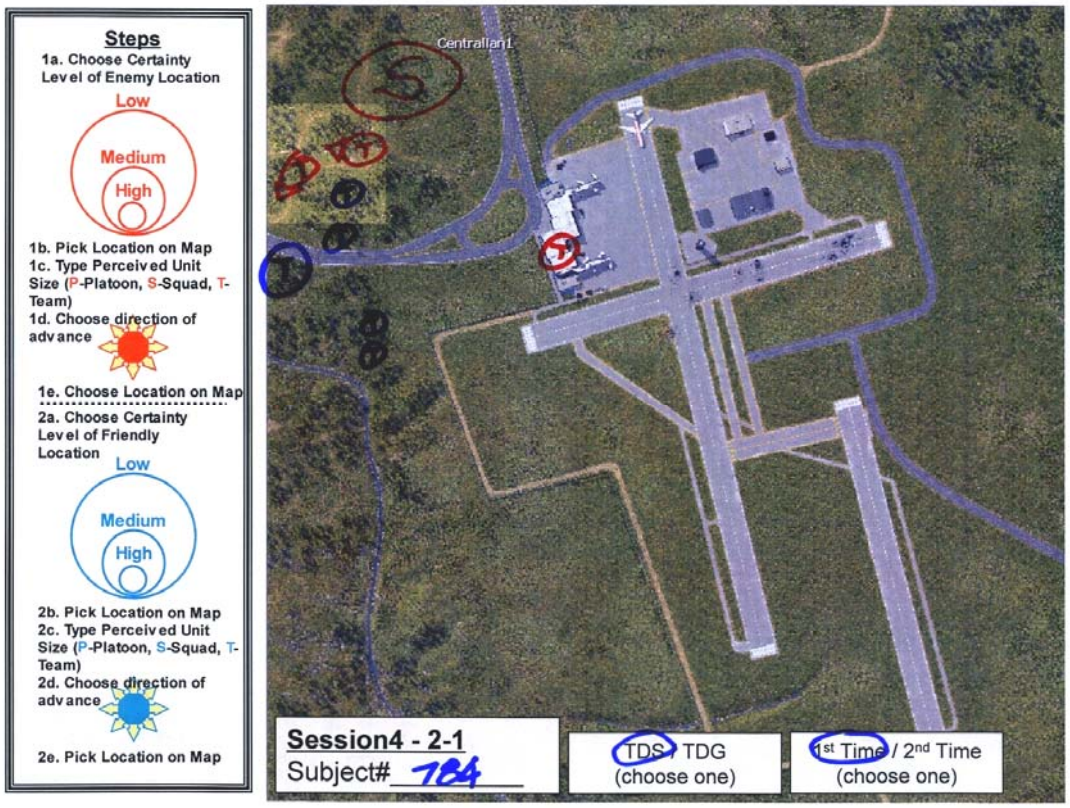
APPENDIX M - EXAMPLE GRADE SA SHEET (EXPERIMENT 2)

Geographical Recall and Analysis of Data in the Environment (GRADE)



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APPENDIX N - EVALUATION FORM (EXPERIMENT 2)

TDS - Platoon Leader Leadership Evaluation Sheet										
Subject #:										
Team:	Offense / Defense									
Evaluator:										
Date/Time:										
Likert Scale (1) Poor to (7) Excellent										
#	**Knowledge and skills:**		**Platoon Leader's Current Level**							
			Poor						**Excellent**	
	PLANNER									
1	Understood Operations Order	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	
2	Identified Enemy Most Probably Course of Action (MPCOA)	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	
3	Created a Scheme of Maneuver (SOM)	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	
4	Considers Adjacent Units	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	
5	Created a Fire Support Plan (FSP)	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	
6	Identified Secondary MPCOA	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	
7	Considered the following in Mission Planning Process	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	
8	- Mission	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	
9	- Enemy	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	
10	- Troops Available	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	
11	- Terrain	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	
12	- Time	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	
	DECISION MAKER									
13	Identified Enemy of Center of Gravity and Attacks It.	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	
14	Adjusted to Enemy Situation	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	
	LEADER / COMMANDER									
15	Took Charge	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	
16	Maintained Oversight of All Subordinate Units	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	
	COMMUNICATOR									
17	Communicated His Plan/Intent to Subordinates	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	
18	Ensured that Subordinates did what they had been told	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	
	TACTICALLY CUNNING									
19	Used deception and creativity to outwit the enemy	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	
20	Deviated from doctrine when necessary	**NA**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	
Source: TBS's Five Pillars of Leadership (Evaluated by instructor and survey results)										

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APPENDIX O - PRESENTATION OF WORK

On numerous occasions, we had the opportunity to present this work to the NPS Human Factors Focus group and during the Modeling Virtual Environments and Simulation (MOVES) Open House. Throughout 2006 and 2007 as we would come up with a new idea or completed a component of this thesis, we would ask for some time in the schedule to present our findings to the Human Factors Focus Group at NPS MOVES Institute. This group was a collection of students and professors who were interested in the human experience within virtual environments. We received many suggestions and constructive comments on our work. Once we had completed Experiment 2, we had the privilege of presenting our overall findings at the 2007 MOVES Open House in July 2007. We were pleased with the response from the audience and were happy to see that our work had been of interest to some within the military and from the private sector as well.

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